INTERIM RECORD OF DECISION

FORMER UNITED ZINC AND ASSOCIATED SMELTERS
OPERABLE UNIT 01

FORMER UNITED ZINC and ASSOCIATED SMELTERS
SUPERFUND SITE
ALLEN COUNTY, KANSAS

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6/8/2017
Date

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DECLARATION

SITE NAME AND LOCATION

Former United Zinc and Associated Smelters Superfund Site
OU1 Residential Contamination
Allen County, Kansas

EPA Superfund Site Identification Number KSN000705026

STATEMENT OF BASIS AND PURPOSE

This Interim Record of Decision (IROD) documents the U.S. Environmental Protection Agency's selection of a remedy for contaminated residential properties at the Former United Zinc and Associated Smelters site (FUZ or Site), Operable Unit (OU) 1, chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, 42 U.S.C. §§ 9601 - 9675, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision is based on the Administrative Record, which is available online at https://semspub.epa.gov/src/collection/07/AR63756.

The Director of the Kansas Department of Health and Environment (KDHE) concurs with the Selected Remedy (see Appendix III).

ASSESSMENT OF THE SITE

The Selected Interim Remedy is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

DESCRIPTION OF THE INTERIM SELECTED REMEDY

The EPA believes the Interim Selected Remedy for FUZ OU1, Alternative 2 – Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls appropriately addresses the current and potential risks to human health and the environment. The Interim Selected Remedy addresses human health risks through remediation of residential properties, which includes residential yards, public use areas and child high-use areas, to below 400 parts per million (ppm) lead and 35 ppm arsenic. This is the first of two planned remedial phases, or operable units, for the Site. Former smelter locations and properties that may have been used to dispose of smelter waste will be addressed under OU2.

The major components of the Interim Selected Remedy for OU1 include the following actions:

- excavation of an estimated 112,000 cubic yards of soil contaminated primarily with lead and arsenic from approximately 902 residential properties in the city of Iola;
- off-site disposal of excavated contaminated soil, and backfilling of excavated areas with clean fill;
- restoration of the affected properties;

- health education for all stakeholders at the Site to inform about the risks and ways to reduce human exposure to contamination; and
- institutional controls (ICs) managed at a local level which may include:
    - establishment of a registry of residential properties that have greater than 1,200 ppm lead at 12 inches below ground surface (bgs) with the city of Iola or Southeast Kansas Multi-County Health Departments to facilitate access to and remediation of those properties in the future;
    - specific scrutiny of yards subject to the ICs during each 5-year review to ensure the remedy has remained protective;
    - possible building permit requirements that would involve pre-screening properties for lead;
    - builder and developer education programs for dealing with heavy metal soil contamination and best management practices for construction workers; and
    - deed restrictions or environmental covenants.

The estimated 30-year present-worth cost of the Interim Selected Remedy, with a seven percent discount factor, is $19.8 million.

STATUTORY DETERMINATIONS

The Interim Selected Remedy meets the requirements for remedial actions set forth in CERCLA Section 121, 42 U.S.C. § 9621, and the NCP at 40 CFR Section 300.430(f)(1)(ii) because it: 1) is protective of human health and the environment; 2) meets a level or standard of control of the hazardous substances, pollutants and contaminants which at least attains the legally applicable or relevant and appropriate requirements under federal and state laws or justifies a waiver; 3) is cost-effective; and 4) utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. In addition, Section 121 of CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances as a principal element (or requires a justification for not satisfying the preference).

Treatment is not a principal element of the remedy selected herein because the excavated soil is expected to pass the Toxicity Characteristic Leaching Procedure (TCLP) test. However, it is possible that some excavated soil may fail the TCLP test. If this occurs, the excavated soil may require treatment prior to disposal at a sanitary landfill. Off-site treatment, if required, would reduce the toxicity of the contaminated soil prior to landfill disposal.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, the EPA will conduct a review as required by CERCLA within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

IROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary of this IROD:

- chemicals of concern and their respective concentrations;
- baseline risk represented by the chemicals of concern;
- cleanup levels established for chemicals of concern and the basis for these levels;

- how source materials constituting principal threats are addressed;
- current and reasonably anticipated future land use assumptions;
- potential land use that will be available at the Site as a result of the Selected Remedy;
- estimated capital; annual operation and maintenance; and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected; and
- key factors that led to selecting the remedy.

Additional information can be found in the Administrative Record for OU1.

Mary P. Peterson

Mary P. Peterson, Director
Superfund Division

6/8/2017

Date

Interim Record of Decision – Decision Summary

Residential Contamination – Operable Unit 1
Former United Zinc and Associated Smelters Superfund Site
Allen County, Kansas

SITE NAME AND LOCATION

The Former United Zinc and Associated Smelters Superfund site (FUZ or Site), U.S. Environmental Protection Agency Superfund Site Identification Number KSN000705026, is located in the city of Iola, Allen County, Kansas. The Selected Remedy described herein addresses contaminated soils at residential properties and residential-type properties inside the city limits with soil contamination above the site-specific cleanup goals of 400 parts per million (ppm) for lead and/or 35 ppm for arsenic. The EPA is the lead agency and the Kansas Department of Health and Environment (KDHE) is the support agency. The EPA plans to conduct the remedial action utilizing the Superfund Trust Fund.

SITE DESCRIPTION

The Site consists of two types of contaminated residential properties: properties with contamination associated directly with smelting operations (potential source areas), and properties affected by pollution and waste that was removed from contaminant source areas and transported to other locations by unidentified transporters. Three potential source areas include the former smelter facilities of United Zinc, East Iola, and IMP Boats. In addition, a Preliminary Assessment (PA) report for the Coberly Recycling facility dated July 14, 1995, indicates that lead contamination as high as 47,000 ppm was encountered when an underground storage tank (UST) was removed from the property. It is likely that smelter waste was used as fill material when the tank was first installed below the ground. A detailed description of the former smelter and suspected waste disposal properties is contained in the Remedial Investigation (RI) and is summarized below:

Former United Zinc: The 16.1-acre property is zoned for commercial and industrial use. It consists of eight parcels with the following addresses: 1520 and 1602 East Street; 0, 1402, 1420, 1505, and 1508 Monroe Street; and 0 Rt 3. Residential properties border the former smelter property to the north and commercial properties border it to the south, east and west. Smelting at this location began in 1901 and ceased in 1912. Analysis of samples collected from the property indicates lead levels as high as 49,000 ppm.

East Iola: The 3-acre property consists of two parcels with the following addresses: 1802 and 1806 East Street. The property is classified as commercial. Residential properties border the property to the north with commercial properties bordering to the south, east and west. The smelter at this location operated between 1899 and 1925. Analysis of samples collected from the property indicates lead levels as high as 7,972 ppm.

IMP Boats (Lanyon 1 & 2): Approximately 31 acres of the 42.7-acre Lanyon 1 & 2 property are within the city limits; the remaining 12 acres along the southwestern portion of the property are outside the city limits. The property is zoned for commercial or industrial use. It consists of 13 parcels with the following addresses: 0, 500, and 505 Lincoln; 0 Railroad; 0, 713, and 801 Industrial; and 0 Rt 1. Smelting began at this property in approximately 1896 and continued until

sometime in the 1920s. Analysis of samples collected from the property indicates lead levels as high as 54,593 ppm.

Coberly: The 3.4-acre property is zoned for commercial or industrial use. It consists of three parcels. The parcel addresses are 1206 East Street, and 1 and 117 Kentucky Street. Commercial properties surround the entire property. No smelting was known to have occurred at the Coberly property. However, previous investigations reveal that the property had a pile of smelter waste on it at one time. The pile has been removed, but contamination remains. A 500-gallon UST was removed from the property in 1992. Soil samples collected during the UST removal show lead concentrations as high as 47,000 ppm.

In addition to the source areas, there are contaminated parcels (residential and residential-type properties) within the city of Iola. An additional impacted area includes heavily contaminated parcels that extend along an abandoned rail line in the southeastern portion of Iola.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

The city of Iola was an international center for zinc and lead smelting until the end of World War I, with multiple smelters operating in Iola and the adjacent towns of Gas and La Harpe. The development of shallow natural gas fields in the vicinity of Iola at the end of the 19th century, along with existing rail access, helped transition the smelting industry from primarily coal-fired works in the Pittsburg, Kansas, area to areas where natural gas was abundant. Most of the smelters in this area provided zinc for galvanizing; mined zinc was sent to the steel mills of Ohio, Pennsylvania, and New Jersey for further processing. Though lead was often not the primary metal being smelted, it was present as waste in the slag material.

Smelting activities were conducted at the former United Zinc, East Iola, and IMP Boats facilities in Iola from 1896 to the 1920s and were primarily related to the processing and smelting of ores containing lead, arsenic, cadmium, barium, and zinc. Heavy metals contamination was deposited across the city of Iola via atmospheric deposition from smoke stacks, deposition through atmospheric and water runoff from waste piles, the use of smelter wastes as road base, and the use of smelter waste in railroad ballasts. Residents have also stated that smelter wastes were used as fill around houses, sidewalks, and driveways.

KDHE Investigations

In June 2005, KDHE completed an investigation that focused on an Iola preschool, McKinley Elementary School, and 50 residential properties located southwest and northeast of the Former United Zinc and East Iola smelter sites and the Coberly waste area. The 50 residences were randomly sampled and located between the schools. Of the 50 residences sampled, 18 properties had lead soil contamination above 400 ppm. This was the Regional Screening Level (RSL) for lead in soil in 2005[1]. Lead was found at levels up to 2,020 ppm in soil samples (KDHE, 2005a).

KDHE completed a Preliminary Removal Site Evaluation (RSE) in September 2005, which included the collection of samples from the schools sampled in June 2005. Lead concentrations exceeding 400 ppm were reported for samples collected from the McKinley School and adjacent areas. However, the lead

[1] The Removal Management Level (RML) for lead, formerly 800 ppm, was recently lowered to the EPA's RSL, which is 400 ppm.

concentrations reported for the samples collected from the preschool were less than 400 ppm. On September 29, 2005, KDHE referred the Site to the EPA's Removal Program for assessment and completion of a removal action (KDHE, 2005b).

CERCLA Response Actions

The EPA's Removal Program sampled 260 properties in the city of Iola, including 234 residential properties, 15 daycare centers, 5 public school yards, 2 churches, and 4 commercial areas from April to May 2006. Results showed elevated lead concentrations throughout the city, with the higher concentrations more prevalent in older neighborhoods. Lead was found in surface soil at levels up to 2,290 ppm at residential properties and 6,433 ppm at commercial properties. The Removal Program expanded sampling efforts to include an additional 1,414 residential properties. Of the total 1,674 properties sampled, 140 properties met the criteria for a time-critical removal action (TCRA) and 403 properties met the criteria for a non-time-critical removal action (non-TCRA). A CERCLA response action was not warranted for the remaining 1,131 properties.

As part of the Remedial Investigation (RI), the EPA's Remedial Program sampled 1,000 residential properties from spring 2013 through January 2014, and determined that 350 residential properties met the TCRA criteria. Three hundred properties were not included in the evaluation because owners were either not located or declined to grant access. TCRA and Non-TCRA criteria are described below:

- TCRA
  - Residential property where the soil contains lead concentrations equal to or greater than 800 ppm;
  - High child impact areas such as schools and daycare facilities where the soil contains lead concentrations over 400 ppm;
  - Residences where a child resides with a blood lead level of 10 micrograms per deciliter (µg/dl) or greater and the soil contains lead concentrations over 400 ppm; and
  - Commercial properties where the soil contains lead concentrations equal to or greater than 1,000 ppm.
- Non-TCRA
  - Residential property where the soil contains lead concentrations greater than 400 ppm but less than 800 ppm.

The EPA's Removal Program has completed two of three planned TCRAs at the Site. The first TCRA was conducted from August 15 to November 13, 2006, and from March 13 to June 21, 2007, in accordance with an Action Memorandum dated August 4, 2006. Contaminated soil was removed from 129 properties. These properties included two residences of children with a blood lead level of 10 µg/dL or greater.

In June 2007, the EPA issued a Finding of Imminent and Substantial Endangerment to conduct a second TCRA at the McKinley Elementary School after soil disturbance work on the school grounds resulted in the spreading of lead-contaminated soils throughout the school playground. This second TCRA began on June 21, 2007, and was completed the following day on June 22, 2007.

The EPA is conducting a third TCRA in accordance with an Action Memorandum, dated August 6, 2015, to address an additional 350 residential properties. As of May 20, 2016, contaminated soil has been removed from 104 properties.

The Site was added to the National Priorities List (NPL) on May 21, 2013. The NPL listing allows the EPA to address properties at the Site that could not be addressed by the EPA's Removal Program.

CERCLA Enforcement Activities

The EPA has researched the companies that were involved in the early zinc smelting activities at the Site. Most of these companies are defunct with no known successors. The EPA has identified two parties believed to be successor companies to parties that were involved in zinc smelting at the Site, Mueller Industries, Inc. (Mueller) and Cypress Amax Minerals Company (Cyprus Amax). The EPA believes that Mueller is a successor to the United States Smelting Company, and Cyprus Amax is a successor to the American Metal Company. A general notice letter was sent to both Mueller and Cypress Amax on July 27, 2016.

COMMUNITY PARTICIPATION

The public was encouraged to participate in the Proposed Plan process in development of this ROD. The Proposed Plan highlighted key information from the RI Report, Feasibility Study (FS) Report, Baseline Human Health Risk Assessment (HHRA), and other supporting documents in the Administrative Record. Additionally, the public has been made aware of the environmental issues in the county through fact sheets, public availability sessions and press releases during the previous removal actions that have occurred and continue at the Site.

The Proposed Plan for OU1 was released for public comment on August 8, 2016. The Proposed Plan and other site-related documents were made available to the public in the Administrative Record file maintained at the EPA Region 7 Superfund Records Center at 11201 Renner Boulevard in Lenexa, Kansas. The Administrative Record file is also available online at: https://semspub.epa.gov/src/collection/07/AR63756.

The notice of availability was published in the Iola Register from August 5, 2016 through August 8, 2016. To provide the community with an opportunity to submit written or oral comments on the Proposed Plan for OU1, the EPA established a 30-day public comment period from August 8 to September 7, 2016. On September 1, 2016, the EPA received an extension request. The comment period was extended through October 7, 2016, to accommodate this request. Notice of the extension was published in the Iola Register on September 7, 8, 10, 12, 13.

A public meeting was held on August 25, 2016, at 6:30 p.m. at the Iola Public Library in Iola, Kansas, to present the Proposed Plan, accept written and oral comments, and answer any questions concerning the proposed cleanup. Comments that were received by the EPA at the public meeting and in writing during the public comment period are addressed in the Responsiveness Summary.

SCOPE AND ROLE OF THE RESPONSE ACTION

As with many Superfund sites, the problems at the Former United Zinc and Associated Smelters Superfund Site are complex. As a result, the EPA has organized the work into two operable units (OUs).

- OU 1: Residential Contamination
- OU 2: Source Areas

The first OU, the subject of this IROD, addresses residential properties contaminated with lead and arsenic resulting from historic smelter emissions and improper disposal of smelter waste. The second OU will address contamination at former smelter locations and non-residential properties that may have been used to dispose of smelter waste. It is anticipated that groundwater, surface water, sediment and fish tissue will be addressed under OU2. The Selected Remedy for OU1 is a continuation of the removal actions (OU00) conducted by the EPA's Removal Program under the 2015 Action Memorandum. OU00 will be considered complete once the OU1 remedial action begins.

Residential properties are defined as any area that is highly accessible to sensitive populations (children less than seven years of age and pregnant or nursing women), and includes properties containing single and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, child care facilities, community centers, parks, greenways, and any other areas where children may be exposed to site-related contaminated media. Residential yards contaminated solely from other sources, such as lead-based paint, will not be addressed under CERCLA authority and will be referred to the city of Iola or the Southeast Kansas Multi-County Health Department for assessment.

Modification of residential yards over the past century resulting from filling, grading, or other earth-disturbing activities has potentially covered or diluted surface lead contamination. These earth-disturbing activities are expected to vary from property to property and within individual properties. Due to the high degree of variability in surface lead concentrations, OU1 includes only those properties that have soil lead concentrations at or above the cleanup level of 400 ppm at the surface. Because arsenic and lead are collocated, addressing residential properties with lead concentrations at or above 400 ppm will also address properties with arsenic concentrations at or above the cleanup level of 35 ppm. In addition, the Selected Remedy will address any non-foundation soil (i.e., samples collected away from the foundation and away from the influence of flaking paint) having arsenic at or above 35 ppm with lead below 400 ppm.

As of June 2016, approximately 2,684 individual properties have been sampled. Of these, approximately 479 have been or will be addressed by the EPA's Removal Program. It is anticipated that an additional 300 properties will be evaluated by the Remedial Program. Owners of these 300 properties have been difficult to contact for access. Efforts to get sampling access will continue during the remedial action. The precise number of residential properties that will require soil remediation under the OU1 remedy will be determined once soil samples are collected from all 300 of the unsampled properties.

SITE CHARACTERISTICS

Conceptual Site Model

The Conceptual Site Model (CSM) (see Figure 2.3 of the RI) developed for the Site depicts wastes from smelter operations that are impacting surface soil and surface water. The main mechanisms for the release of these wastes to the environment was by physical placement of smelter wastes on the ground and aerial deposition through stack emissions. A portion of the contaminants are still exposed at the ground surface in the form of spent ore and mine tailings piles. Although most metals are expected to be chemically or physically bound to soil particles, contaminants migrate through erosion, leaching, and air transport mechanisms. Precipitation falling on exposed wastes has the potential to continue to transport metals into surface water through erosion and runoff, as well as leach metals to groundwater, and contaminants can be transported through wind erosion.

Metals may become part of a soil or sediment mass through precipitation (formation of oxides, hydroxides, carbonates, salts, and other forms) or through absorption (binding to fine-grained soil particles or organic matter). Soils and sediments can become sinks for heavy metals. Metals generally have low water solubility, resulting in limited ability to dissolve in surface water or groundwater under ambient conditions. They also tend to partition out of the aqueous phase onto organic matter or fine-grained soil particles. These metals properties, combined with their natural corrosion resistance, result in them being immobile and persistent in the environment. Sorption to soil particles and organic matter, and precipitation as metal oxides, are the primary means of entrainment of metals contamination in the environment.

Surface Features

Topography varies minimally throughout Allen County. The land is predominantly level with few outstanding differences in the relief. The Site is generally flat land and slopes slightly to the south toward Rock Creek, Elm Creek, and the Neosho River. The elevation of the ground surface across the Site ranges from 980 feet above mean sea level (amsl) to 1,040 feet amsl. The higher elevations are in the northeast corner of town, and the lower elevations are along the creeks and rivers.

Geology

The Site and its surroundings lie at the edge of a late Paleozoic structure called the Cherokee Basin, which is present in the southern part of Allen County. The basin is an area with a thicker sequence of sedimentary deposits with respect to the arches in the area. The Bourbon Arch extends into the north portion of the county. These structural features are responsible for the natural gas deposits mined below the Site region. In general, the geology of the Site area consists of late Paleozoic-aged bedrock.

The most prevalent bedrock formations beneath Iola are the Bonner Springs and Lane shales and the Iola Limestone of the Kansas City Group. These two undifferentiated shales have an average thickness of approximately 60 feet. Most exposures of Iola Limestone lie in drainage ways where erosion has cut through the overlying Bonner Springs and Lane shales.

Hydrology

The regional topography of the area is flatlands with small bluffs on the cut banks of the Neosho River. The elevation of the Site ranges from approximately 980 to 1,040 feet amsl. Several surface water features are located near the Site. Rock Creek flows from northeast to southwest into Elm Creek and is located approximately 2,200 feet south of IMP Boats and the Coberly waste area. Elm Creek, a major tributary of the Neosho River, flows to the west and is located approximately 4,200 feet southwest of IMP Boats.

According to information obtained from the Kansas Geological Survey water well database for Allen County, the depth to groundwater in wells in Iola ranged from approximately 6 to 15 feet bgs depending on the general ground elevation and proximity to the Neosho River. Shallow groundwater flow beneath Iola is probably toward the south and/or southwest. This conclusion is based on the following:

- presence of the major discharge feature, the Neosho River, immediately to the west and southwest of Iola; and
- topography and drainage sloping toward this river valley and Rock Creek.

Domestic groundwater use in the Iola area is minimal. During the RI sampling, a concerted effort was made to identify private wells for sampling; only three domestic wells could be located for sampling. The city of Iola uses the Neosho River as the source of its municipal water system.

Remedial Investigation

Sampling Strategy

RI sampling efforts focused primarily on soil characterization at residential properties, which included schools, parks, churches, daycare facilities, and vacant lots owned by the city of Iola. Previous sampling efforts, primarily the 2006-2007 removal action, were used to help delineate the nature and extent of contamination. RI sampling activities were conducted from May 6, 2013, through April 8, 2014, and were performed in accordance with the EPA's *Superfund Lead-Contaminated Residential Sites Handbook*, Office of Solid Waste and Emergency Response (OSWER) 9285.7-50.

Generally, four composite soil samples are collected from mid-yard areas at each property. At a typical residential property, the front yard and back yard are each divided in half. Five individual aliquots are collected at a 0- to 1-inch depth from each of the four quadrants and combined to form the four composite samples. An additional four-aliquot composite sample is typically collected from the drip zone area (6 to 30 inches from the foundation wall) by combining one aliquot collected from exposed soil on each side of the residence.

The analytical results of residential soil samples were compared to the risk-based Residential Soil Regional Screening Levels (RSLs), as defined in the EPA's 2016 RSL Summary Table[2]. The surface soil sample analytical results were provided to EPA risk assessors for the HHRA and ERA. The subsurface soil sample analytical data were used to evaluate exposure pathways, including potential lead leaching into subsurface soils in the upper 24 inches. Subsurface samples show that the highest concentrations are located at the surface.

A total of 7,398 surface soil samples (0 to 1 inch) and 202 subsurface soil samples (1 to 24 inches) were collected from the 1,034 residential properties during the RI sampling effort. Samples were submitted for field screening using a portable XRF analyzer. The analytical method employed was EPA Method 6200 Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. From the 7,398 surface soil samples analyzed on site, 799 samples (including field duplicates) were submitted for confirmation analysis. Of the 202 subsurface soil samples collected, 8 (including field duplicates) were submitted for confirmation analysis. Confirmation samples were analyzed at the EPA Region 7 laboratory using EPA Method 6010C for target analyte list metals: aluminum, antimony, arsenic, barium, beryllium, calcium, cadmium, total chromium, cobalt, copper, iron, lead, magnesium, manganese, potassium, nickel, selenium, silver, sodium, thallium, vanadium, and zinc. Select soil samples also were analyzed for total organic carbon (EPA Region 7 Regional Laboratory [RLAB] Method 3151.2D).

[2] The Removal Management Level for lead, formerly 800 ppm, was recently lowered to the EPA's RSL, which is 400 ppm.

In 2015 and 2016, the EPA conducted an Arsenic Reanalysis Study to determine whether arsenic concentrations might necessitate a soil removal action on properties where lead concentrations were below the EPA RML of 400 ppm. Of the original 7,398 surface soil samples, 2,822 were reanalyzed using a portable XRF analyzer. Of the original 202 subsurface soil samples, 16 were reanalyzed using XRF. A total of 363 confirmation samples were submitted to the EPA Region 7 laboratory for analysis.

Site Characterization Summary and Results

Surface Soil - Lead

Lead concentrations in surface soils ranged from 9 ppm to 66,445 ppm. The highest concentration was observed on a property abutting the south side of the former railroad right-of-way (ROW) south of the Eastern Source Properties (Plate 5, Appendix I). Of the 7,398 lead detections, 2,070 exceeded the lead RSL of 400 ppm. Properties with RSL exceedances are highlighted in red on Plate 5. The properties highlighted in orange are those where lead was detected above the average background concentration of 52.4 ppm but below the RSL. As illustrated, lead levels above the RSL blanket the center of Iola from east to west. Lower concentrations (above background but below the RSL) are prevalent in the northeast and far northwest portions of the city.

The isoconcentration map in Plate 6 (Appendix I) was produced by interpolating between the data points (sample concentrations) using the natural neighbor method for the lead screening data from 2013 through 2016. The highest concentration at each property was plotted in the center of each property for the data interpolation. Plate 6 further illustrates the widely scattered lead concentrations above the RSL of 400 ppm throughout the central portion of the study area. Hotspots of higher lead detections are plotted around the former United Zinc and IMP Boats source area properties, and the former railroad ROW south of the Eastern Source Area. Other hotspots lie farther south of the railroad ROW just northwest of Rock Creek and on the south margin of the contoured area on the north side of Elm Creek. Other smaller hotspots exist throughout the city of Iola.

Surface Soil - Arsenic

Arsenic was detected in 766 of the confirmation surface soil samples at concentrations ranging from 5 ppm to 221 ppm (Table 4.5). All detected concentrations exceeded the arsenic cancer risk RSL of 0.68 ppm[3] and 762 exceeded the average background level of 5 ppm. The highest concentration was observed in sample 6108-48 (Table 4.9) collected from property 3177, located approximately 2,200 feet northwest of the former United Zinc source property (Plate 7, Appendix I). Because arsenic was detected in most samples, and all detections exceeded the RSL, the presence of arsenic above the RSL is widespread across the Site area (Plate 7).

In the reanalysis confirmation samples, 425 of the 447 surface soils had arsenic concentrations above the background level of 5.0 ppm and all detections exceeded the cancer risk RSL of 0.68 ppm. Plate 7 illustrates the highest arsenic concentration by property in the combined confirmation data from both the 2013 and 2014 field effort, and the 2015 and 2016 arsenic reanalysis study. The highest arsenic concentration in the confirmation data (109 ppm) was detected at location 3360-C25 on property 3360.

As a result of the arsenic reanalysis study, lead concentrations at an additional 9 properties were observed over the RML of 400 ppm.

[3] Based on a cancer risk of 1E-06.

Surface Soil - Barium

Barium was detected in all 791 confirmation surface soil samples at concentrations ranging from 29.8 ppm to 1,220 ppm (Table 4.5). Of these, 377 detections exceeded the barium background concentration of 180 ppm, but none exceeded the RSL of 1,500 ppm.[4] Barium is ubiquitous throughout the Site, with no apparent pattern to the detections above or below background.

Surface Soil - Cadmium

Cadmium was detected in 775 of the off-source surface soil samples at concentrations ranging from 0.57 ppm to 88.9 ppm (Table 4.5), of which 190 exceeded the RSL of 7.0 ppm and 363 exceeded the average background concentration of 4.9 ppm. The highest concentration was observed in sample 6107-44 (Table 4.8) collected from property 2445, located approximately 2,500 feet southeast of the IMP Boats source property (Plate 8, Appendix I). Cadmium concentrations above the RSL are more concentrated along the eastern and southeastern boundary of the Site area, along the line of the former railroad ballast, and south-southeast of the IMP Boats source property (Plate 8). Thus, the cadmium is likely attributable to the former smelting processes.

Surface Soil - Zinc

Zinc was detected in all 791 of the off-site surface soil samples at concentrations ranging from 68 ppm to 55,300 ppm (Table 4.5) of which 687 exceeded the RSL of 2,300 ppm and 363 exceeded the average background concentration of 688 ppm. The highest concentration was observed in sample 6224-29 (Table 4.13) collected from property 2685, located south of the former United Zinc source property along the former railroad ROW (Plate 9, Appendix I). Zinc concentrations above the RSL are more concentrated to the west of the Eastern Source Area, along the line of the former railroad ROW, and east and southeast of the Western Source Area.

Subsurface Soil - Lead

Lead in subsurface soils ranged from 18 ppm to 2,949 ppm in the 202 samples collected across the four depth intervals (Table 4.4). Both the maximum and minimum values were observed in the 6- to 12-inch interval. Table 4.4 shows that both detections and concentrations exceeding the RML decrease with depth. This trend would be expected outside the source areas because migration of the metals contamination was primarily from surface deposition via air and surface water runoff. Plate 13 (Appendix I) illustrates the lead in the subsurface sample intervals 0 inches to 6 inches, 6 inches to 12 inches, 12 inches to 18 inches, and 18 inches to 24 inches. Lead detections above the RML of 400 ppm were dispersed throughout the central and south-central portions of Iola. At properties 2546, 2594, and 3232, lead in subsurface soils exceeded the RSL or background in all four depth intervals. In general, throughout the sampled area, lead detections exceeding the RML of 400 ppm were generally sparse below 12 inches bgs.

There were 16 screening subsurface soil samples and two confirmation subsurface soil samples in the Arsenic Reanalysis Study. Lead in subsurface soils ranged from 51 ppm to 443 ppm in the 16 screening samples reanalyzed in 2015 and 2016 (Table 4.14). Three of the samples had detections exceeding the RSL of 400 ppm. The highest concentration was observed in sample 4056-C3 (property 4056), located

[4] Based on a non-cancer hazard quotient of 0.1.

1,600 feet west-northwest of the IMP Boats source property. The other properties with subsurface lead concentrations above the RSL are located west of the former United Zinc source property about 1,600 feet (property 2927) and 2,600 feet (property 2891).

Subsurface Soil - Arsenic

There were 16 screening subsurface soil samples and two confirmation subsurface soil samples in the reanalysis study. All subsurface samples reanalyzed were from the 0- to 6-inch depth intervals. Arsenic in subsurface soils ranged from 7.0 ppm to 19.1 ppm in the 16 screening samples reanalyzed in 2015 and 2016 (Table 4.14). The arsenic detections in all 16 samples exceeded the cancer risk RSL of 0.67 ppm[3]. The highest concentration was observed in sample 4056-C3 (property 4056), located 1,600 feet west-northwest of the IMP Boats source property. This sample also had the highest subsurface lead detection in the reanalysis study.

Subsurface Soil – Other Metals Associated with Smelter Activities

Barium, cadmium, and zinc were all reported at levels less than their respective RSLs for the subsurface soil samples.

CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

Land use at the properties which comprise OU1 is residential and residential-type parcels. Since OU1 is defined to include only residential and residential-type properties, commercial and industrial properties within the Site are not considered part of OU1. The Site is located entirely within the city limits of Iola, Kansas, where local zoning ordinances control land use. The Site is bordered by adjacent parcels used for agriculture. The continued residential use of property can be reasonably assumed for the majority of the properties that comprise OU1 through local zoning control. In the future, some of the current residential properties may convert to nonresidential use.

Numerous nonresidential properties, including parcels where the former smelters were located, exist within the larger residential area. As noted above, these areas are part of OU2 and are not being addressed by the Selected Remedy.

SUMMARY OF SITE RISKS

A Baseline HHRA was conducted for the Site by the EPA. The May 2015 HHRA assesses the potential risks to humans, both current and future, from site-related contaminants present in environmental media including surface soil, sediment, surface water, groundwater, and fish tissue. The HHRA assumes that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media. The results of the HHRA are intended to inform risk managers and the public about potential human health risks attributable to site-related contaminants and to help determine if there is a need for action at the Site.

The risks to residential children from exposure to lead in surface soil were evaluated using the Integrated Exposure Uptake Biokinetic Model (IEUBK) to derive a soil lead cleanup concentration resulting in no more than a 5% chance of a typically exposed child having a blood lead level greater than or equal to a target blood lead level of 10 µg/dL. However, the current scientific literature on lead toxicology and epidemiology provides evidence that adverse health effects are associated with blood lead levels less

than 10 µg/dL. In light of emerging information on lead and protectiveness levels, the current decision is an interim action and will be revisited as more information becomes available.

EPA Region 7 is executing the actions outlined in the July 2016 Proposed Plan as an interim action while this new information emerges. Therefore, this is an interim action which will be reexamined after the emerging information can be fully evaluated.

A recreational child or adult exposed to lead in sediment in a non-residential setting will not be addressed by this action.

Site-wide cancer hazards and cancer risks for residents exposed to non-lead contaminants of potential concern (COPCs) in soil were evaluated. The total non-cancer hazard index (HI) for the Reasonable Maximum Exposure (RME) child resident based on the 2013 data exceeds a level of concern, but the non-cancer HI for the RME adult resident based on the 2013 data is within USEPA guidelines. For the child, thallium is the primary risk driver. However, the detection frequency of thallium was only 0.3%, and the average detection level was higher than the USEPA residential soil screening level. Thus, the true thallium concentration in soil to which a resident will be exposed via incidental ingestion may be below a level of concern, but the detection limit is too high to estimate a reliable Exposure Point Concentration (EPC).

Table 4-9. Summary of Estimated Non-Cancer Hazard to Non-Lead COPCs

Dataset	Exposed Population	Exposure Medium	Exposure Route	Non-cancer HI CTE	Non-cancer HI RME	Risk Drivers
2006/2007 Data	Child Resident	Residential Yard Soil	Incidental Ingestion	2E-01	6E-01	
			Dermal Contact	1E-02	7E-02	
		Medium Total		2E-01	7E-01	
	Adult Resident	Residential Yard Soil	Incidental Ingestion	2E-02	6E-02	
			Dermal Contact	1E-03	1E-02	
		Medium Total		2E-02	7E-02	
2013 Data	Child Resident	Residential Yard Soil	Incidental Ingestion	1E+00	4E+00	Th
			Dermal Contact	8E-03	6E-02	
		Medium Total		1E+00	4E+00	Th
	Adult Resident	Residential Yard Soil	Incidental Ingestion	1E-01	4E-01	
			Dermal Contact	8E-04	8E-03	
		Medium Total		1E-01	4E-01	

Pink highlights flag non-cancer hazards > 1.

The cancer risk for a RME Time-Weighted Average (TWA) resident based on the 2013 dataset is above a 1E-04 level of concern. This exceedance is primarily due to incidental ingestion of total chromium, evaluated as chromium (VI), in residential yard soil. Total chromium was measured in environmental media at the Site, and data on chromium speciation at the Site is not available. Non-cancer hazard and cancer risks from direct contact with chromium were assessed using the reference dose (RfD) and oral slope factor (SF) for chromium (VI), the most toxic form. This is a conservative approach that likely overestimates actual risk. All other cancer risk estimates are within EPA guidelines.

Table 4-10. Summary of Estimated Cancer Risks to Non-Lead COPCs

Dataset	Exposed Population	Exposure Medium	Exposure Route	Excess Cancer Risk		
				CTE	RME	Risk Drivers
2006/2007 Data	TWA Resident	Residential Yard Soil	Incidental Ingestion	4E-06	2E-05	
			Dermal Contact	2E-07	3E-06	
		Medium Total		4E-06	3E-05	
2013 Data	TWA Resident	Residential Yard Soil	Incidental Ingestion	1E-04	2E-04	Cr
			Dermal Contact	2E-07	3E-06	
		Medium Total		1E-04	2E-04	Cr

Pink highlights flag cancer risks >1E-04.

A supplemental evaluation was performed to address the potential significance of evaluating non-lead COPC risks on a property-specific basis rather than a site-wide basis. To evaluate worst-case exposures, the maximum detected concentration of each Chemical of Potential Concern was used as the EPC. The total non-cancer HIs exceed 1 for the RME child resident based on both the 2006-2007 and 2013 datasets, and for the RME adult based on the 2013 dataset. For the 2006-2007 dataset, arsenic is the risk driver. For the 2013 dataset, Hazard Quotient values exceed 1 for arsenic, copper, iron, thallium, and zinc for the RME child.

Table 4-11. Summary of Estimated Non-Cancer Hazard to Non-Lead COPCs (EPC =Max)

Dataset	Exposed Population	Exposure Medium	Exposure Route	Non-cancer HI		
				CTE	RME	Risk Drivers
2006/2007 Data	Child Resident	Residential Yard Soil	Incidental Ingestion	2E+00	6E+00	As
			Dermal Contact	1E-01	7E-01	
		Medium Total		2E+00	7E+00	As
	Adult Resident	Residential Yard Soil	Incidental Ingestion	2E-01	5E-01	
			Dermal Contact	1E-02	1E-01	
		Medium Total		2E-01	6E-01	
2013 Data	Child Resident	Residential Yard Soil	Incidental Ingestion	8E+00	2E+01	As, Cu, Fe, Th, Zn
			Dermal Contact	8E-02	5E-01	
		Medium Total		8E+00	2E+01	As, Cu, Fe, Th, Zn
	Adult Resident	Residential Yard Soil	Incidental Ingestion	7E-01	2E+00	
			Dermal Contact	8E-03	8E-02	
		Medium Total		7E-01	2E+00	

Pink highlights flag non-cancer hazards > 1.

The cancer risk for a RME TWA resident based on both the 2006-2007 and 2013 datasets is above a 1E-04 level of concern. These exceedances are primarily due to ingestion of arsenic, evaluated as inorganic arsenic, and chromium, evaluated as chromium (VI), in residential yard soil. As stated previously, evaluation of total chromium as chromium (VI) is likely to produce an overestimation of actual chromium risk.

Table 4-12. Summary of Estimated Cancer Risks to Non-Lead COPCs (EPC = Max)

Dataset	Exposed Population	Exposure Medium	Exposure Route	Excess cancer Risk		
				CTE	RME	Risk Drivers
2006/2007 Data	TWA Resident	Residential Yard Soil	Incidental Ingestion	4E-05	2E-04	
			Dermal Contact	2E-06	4E-05	
		Medium Total		4E-05	3E-04	
2013 Data	TWA Resident	Residential Yard Soil	Incidental Ingestion	6E-04	1E-03	As, Cr
			Dermal Contact	2E-06	3E-05	
		Medium Total		6E-04	1E-03	As, Cr

Pink highlights flag cancer risks >1E-04.

The non-cancer HI and the cancer risk for the RME child recreational visitor exposed to surface water exceed EPA guidelines. In addition, the cancer risk for the RME adult recreational visitor exposed to surface water exceeds EPA guidelines. The primary contributor to risk is dermal exposure to total chromium evaluated as chromium (VI). As stated previously, evaluation of total chromium as chromium (VI) is likely to produce an overestimation of actual chromium risk.

The non-cancer HIs for the RME child and adult recreational visitors ingesting locally caught fish exceed the USEPA guidelines. The primary risk drivers based on fish consumption are antimony and mercury evaluated as methyl mercury. Total mercury was measured in fish tissue, but non-cancer hazard from the ingestion of mercury in fish tissue was assessed using the RfD for methyl mercury, the predominant form of mercury that accumulates in fish. Since methyl mercury is the most toxic form, this is a conservative (health-protective) approach that may overestimate actual non-cancer hazard to some extent.

Table 4-14[5]. Summary of Estimated Risks to Non-Lead COPCs for Recreational Visitors

Exposed Population	Exposure Medium	Exposure Route	Non-cancer HI			Excess cancer Risk		
			CTE	RME	Risk Drivers	CTE	RME	Risk Drivers
Child Recreational Visitor	Floodplain Soil	Incidental Ingestion	9E-02	4E-01		3E-06	2E-05	
		Dermal Contact	7E-04	7E-03		1E-08	3E-07	
	Medium Total		9E-02	4E-01		3E-06	2E-05	
	Sediment	Incidental Ingestion	2E-01	9E-01		4E-06	2E-05	
		Dermal Contact	3E-03	3E-02		4E-08	1E-06	
	Medium Total		2E-01	9E-01		4E-06	3E-05	
	Surface Water	Incidental Ingestion	2E-02	2E-01		1E-05	1E-04	
		Dermal Contact	3E-01	2E+00	Cr	2E-04	1E-03	Cr
	Medium Total		3E-01	2E+00		2E-04	1E-03	
	Fish Tissue	Ingestion	3E+00	9E+00	Sb, Hg	2E-08	1E-07	
	Total Across Media		4E+00	1E+01		2E-04	1E-03	
Adult Recreational Visitor	Floodplain Soil	Incidental Ingestion	8E-03	3E-02		1E-07	1E-06	
		Dermal Contact	1E-04	2E-03		7E-09	3E-07	
	Medium Total		9E-03	4E-02		1E-07	2E-06	
	Sediment	Incidental Ingestion	2E-02	8E-02		3E-07	4E-06	
		Dermal Contact	5E-04	7E-03		3E-08	1E-06	
	Medium Total		2E-02	9E-02		3E-07	5E-06	
	Surface Water	Incidental Ingestion	2E-03	2E-02		3E-07	8E-06	
		Dermal Contact	2E-01	8E-01		4E-05	4E-04	Cr
	Medium Total		2E-01	8E-01		4E-05	4E-04	
	Fish Tissue	Ingestion	1E+00	3E+00	Sb, Hg	6E-06	5E-05	
	Total Across Media		1E+00	4E+00		4E-05	5E-04	

Pink highlights flag non-cancer hazards and cancer risks above USEPA's level of concern (HI > 1, cancer risk > 1E-04).

Ecological Risk Assessment

The Ecological Risk Assessment determined that lead, zinc and cadmium migrating from the former smelter locations presented significant risks to aquatic and terrestrial life. Ecological risk will be addressed in OU2.

BASIS FOR TAKING ACTION

The response action selected in this Interim Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment, including lead and arsenic.

INTERIM REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs), to-be-considered (TBC) guidance and site-specific, risk-based levels and background (i.e., reference area) concentrations. The following RAOs were established for OU1 of the Site:

[5] This Table 4.14 is from the Human Health Risk Assessment which can be found in Appendix B of the Remedial Investigation report. This is distinctly different from the Table 4.14 mentioned in other sections of the ROD and found in Appendix II.

1) Reduce the risk of exposure of young children to lead such that an individual child, or group of similarly exposed children, is exposed to no more than a level of 400 ppm lead in surface soil.

2) Reduce the risk of exposure to soils containing arsenic such that levels do not exceed the carcinogenic risk of 1 x 10-4 and a non-cancer total HI of 1.

Cleanup Levels

The EPA has adopted the preliminary remediation goals identified in the Proposed Plan as the final cleanup levels for OU1 of the Site. The cleanup levels for OU1 are as follows:

Constituent in Soil	Cleanup Goal (ppm)
Lead	400
Arsenic	35

The EPA has selected 400 ppm as the lead cleanup level for OU1. Cleanup of properties with lead soil contamination at 400 ppm or greater is anticipated to bring the yard-wide average well below 400 ppm. The cleanup of surface soils at or above 400 ppm is anticipated to reduce child blood lead levels to meet the RAO and provide a protective remedy for the community. Also, the use of 400 ppm is consistent with the removal action currently ongoing.

The cleanup level for arsenic in residential soil represents the average concentration of arsenic in a residential yard that is associated with a non-cancer hazard quotient of 1. The cleanup goal for arsenic at OU1 was determined to be 35 ppm. Lead almost always exceeds 400 ppm when arsenic is above 35 ppm; however, the EPA will also excavate soil that only exceeds the arsenic cleanup level wherever it is found.

There is a potential threat of contamination of groundwater from metals in the soils. However, further site-specific data would be required before a more definitive assessment of potential groundwater contamination can be completed. Groundwater, and impact to groundwater, will be evaluated as part of OU2.

DESCRIPTION OF ALTERNATIVES

Three alternatives were considered for OU1. Alternative 1, sometimes called the no action alternative, is considered for every Superfund remedy and is usually used for comparison purposes. Alternatives 2 and 3 are the same except for phosphate treatment of soil with lead between 400 and 572 ppm. Alternative 3 considers phosphate treatment for soil with lower lead concentrations and utilizes excavation only when the concentration is above 572 ppm. Alternative 2 utilizes excavation for all contaminated soil. Both alternatives include the use of health education and institutional controls after soils with a lead concentration of 400 ppm or greater have been addressed.

Description of Remedy Components

Alternative 1: No Action

Time to Construct: 0 years
Capitol Cost: $0
Operation and Maintenance Cost: $60,000
Total Present Worth Cost: $27,820

The No Action Alternative is required by the NCP, 40 C.F.R. § 300.430(e)(6), to provide an environmental baseline against which impacts of various remedial alternatives can be compared. The only action that would be implemented for Alternative 1 is completion of Five-Year Reviews as required by the NCP. There would be no change in the soil contaminant concentrations because no treatment, containment, or removal of contaminated soil is included in this alternative.

The No Action Alternative may be appropriate at some sites where a removal action has already occurred which reduced risks to human health and the environment. Although a removal action to address lead-contaminated soils is ongoing at the Site, the EPA's removal program is not addressing properties with lead contamination between 400 and 800 ppm and arsenic contamination at 35 ppm or greater. Therefore, potential risks due to exposure to contaminated soil would remain at OU1 under this alternative.

Alternative 2: Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls

Time To Construct: 1.5 years
Capitol Cost: $18,887,101
Operation and Maintenance Cost: $884,432
Total Present Worth Cost: $19,771,533

Excavation of Soils with XRF Confirmation to Depth, Disposal, Backfill with Clean Fill and Topsoil, Vegetative Cover

Under this alternative, residential property soils with at least one non-drip zone sample greater than 400 ppm lead will be excavated and disposed. Excavation would continue until the lead concentrations at the exposed surface are less than 400 ppm within the first 12 inches (as determined using XRF). Excavation will stop if lead levels are less than 1,200 ppm at depths of 12 to 24 inches. Should it be determined that lead levels below 1,200 ppm cannot be reached at an excavation depth of 24 inches, excavation will cease and a warning barrier will be placed to alert the property owner to the existence of high lead levels. Excavation will also be performed on the very few quadrants that have arsenic above 35 ppm while lead is below 400. It is unlikely that arsenic will remain above 35 ppm below the first 12 inches of excavation. Provided that lead remains below 400 at 12 inches, excavation will stop at 12 inches in this case. The EPA is confident that risk from arsenic contamination will be addressed by excavation of soil having more than 400 ppm lead. However, the EPA will continue to send ten percent of all property assessment samples for laboratory analysis. Any properties found with 35 ppm arsenic or more would be added to the list for cleanup.

Excavated areas would be backfilled with clean fill and topsoil, returning the property to its original elevation and grade. Sod or hydroseeding would be applied to establish a vegetative cover to restore the

disturbed area, preventing erosion and off-site transport by surface runoff or wind. Excavated soil would be disposed of at the nearby landfill in Eureka, Kansas. Soils that exceed the toxicity characteristic leaching procedure (TCLP) threshold limit of 5 milligrams per liter for non-hazardous waste disposal for lead would be treated on site with a stabilization agent, and would then be resampled and analyzed for lead using TCLP analysis. This procedure would be repeated until the soils pass the lead TCLP threshold limit to allow soil to be disposed of as non-hazardous material at the landfill. Although landfill disposal was used for costing purposes, the EPA will also evaluate other disposal and repository options during the remedial design phase.

Properties where only the drip zone soil exceeds 400 ppm lead or 35 ppm arsenic would not be addressed under this action. The EPA estimates that there are approximately 902 residential properties that contain soils with lead and/or arsenic concentrations that exceed the respective 400 and 35 ppm cleanup levels, and will not have been remediated by the ongoing removal action.

The EPA anticipates that approximately one-and-a-half years will be needed to complete excavation work. The time to implement this alternative could be shortened or lengthened by reducing or increasing the pace of soil remediation.

Health Education

A public information center would be established in Iola in cooperation with KDHE. The information center would have an ongoing lead hazard educational program that would continue through the completion of the remedial action. The public information center would distribute written information on controlling lead hazards and respond to questions from the public concerning EPA response activities. Public health education activities would be conducted providing community education through distribution of fact sheets containing information on controlling lead exposure. The EPA would provide continuing lead hazard information to the public through public media (television, radio, newspapers, and internet).

Additional health education measures considered for this Site include but are not limited to:

- extensive community-wide blood-lead monitoring;
- in-home assessments for children identified with elevated blood lead levels;
- outreach activities directed to area physicians;
- community education meetings and distribution of literature at such presentations as civic clubs, schools, nurseries, preschools, churches, fairs;
- family assistance; and
- special projects to increase awareness of heavy metal health risks.

Institutional Controls (ICs)

ICs are normally used when waste is left on site and there is a limit to the activities that can safely take place at the site (i.e., the site cannot support unlimited use and unrestricted exposure), and/or when cleanup equipment remains on site. Alternative 2 includes ICs because contamination will remain below the ground surface at some properties. At present, there are no applicable zoning ordinances in Allen County for residential properties. However, there are potential ICs that could be utilized. These include but are not limited to the following:

- establishment of a registry of residential properties that have concentrations of lead greater than 1,200 ppm at 12-inches bgs with the city of Iola or Southeast Kansas Multi-County Health Departments;
- yards subject to the ICs will also be extensively evaluated during each 5-year review conducted by the EPA to ensure the remedy remains protective;
- possible building permit requirements that would involve pre-screening properties for lead;
- builder and developer education programs for dealing with heavy metal soil contamination and best management practices for construction workers; and
- deed restrictions or environmental covenants.

Alternative 3: Phosphate Stabilization, Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls

Time to Construct: 1.5 years
Capitol Cost: $35,062,578
Operation and Maintenance Cost: $958,543
Total Present Worth Cost: $36,021,121

This alternative involves a combination of excavation and phosphate stabilization of residential soils and high child impact areas found to contain lead concentrations above 400 ppm. An estimated 902 properties have lead concentrations greater than 400 ppm. Because the previous pilot studies at other sites estimated that the bioavailability of lead can be reduced by 30 to 50 percent, it is conservatively assumed that a phosphate amendment could only be effective at reducing risks associated with lead concentrations in the soils by 30 percent. Consequently, phosphate stabilization would only be conducted on soils with lead concentrations above 400 ppm but less than 572 ppm. Residential properties with lead concentrations above 572 ppm lead or 35 ppm arsenic would be excavated as described in Alternative 2.

Phosphate stabilization would be performed by applying a phosphoric acid (PO_4) gel to the surface along with potassium chloride (KCl). The PO_4 and KCl mixture would be tilled into the soil and allowed to react for at least two weeks. This combination is intended to react with lead in the soil to form the extremely insoluble chloropyromorphite, thus rendering the lead unavailable for leaching and less bioavailable to humans. Following application of the phosphoric acid, lime would be added to raise the soil pH to a normal level, and the property would be sodded.

The total number of residential properties with lead concentrations above 400 ppm and below the effective stabilization level of 572 ppm is estimated to be approximately 452 properties. The remaining 450 properties would be remediated as described in Alternative 2.

In addition, this alternative includes all other activities described in Alternative 2, including public health education and ICs.

Common Elements and Distinguishing Features of Each Alternative

With the exception of the No-Action Alternative, each alternative includes the common elements of health education and institutional controls that address all identified sources of contaminant exposure in the Iola community. These elements will be unchanged regardless of the approach selected in the final remedy for soil remediation.

Both action alternatives are similar in their attainment of key ARARs. The key distinguishing features of the action alternatives relate to the number of yards to be excavated and the use of phosphate stabilization to treat contaminated soils instead of excavation and soil replacement. Under both action alternatives, excavation and soil replacement will be performed at properties where the maximum non-foundation soil lead level exceeds 572 ppm.

Under Alternative 2, excavation and soil replacement will be applied at all properties eligible for remedial action, including those properties with maximum non-foundation soil lead levels between 400 and 572 ppm. Under Alternative 3 however, phosphate treatment would be applied to properties with a maximum non-foundation soil lead level between 400 and 572 ppm; excavation and replacement would be applied to properties with maximum non-foundation lead concentrations exceeding 572 ppm.

Alternative 2 involves the excavation of all properties exceeding 400 ppm. This alternative represents a final remedy for the properties that would be excavated and restored. This alternative does not rely upon treatment in any way to potentially address any of the contaminated site properties.

Alternative 3 includes a combination of excavation and treatment to achieve remedial action objectives. This alternative also constitutes a final remedy for the remaining properties at the Site contaminated at levels above 400 ppm. Phosphate treatment would be applied to an estimated 452 properties with maximum non-foundation soil lead levels between 400 and 572 ppm. Under Alternative 3, excavation and replacement of contaminated soils would be performed for an estimated 450 residential properties where maximum non-foundation soil lead levels exceed 572 ppm, which is the highest lead concentration in Site soils that could be effectively treated. Treated soils would remain on site at individual properties where phosphate treatment is applied.

The primary distinction between alternatives involves the reliance upon a proven, conventional approach to remediation involving the excavation and replacement of contaminated soils versus consideration of a promising, yet unproven, technology to reduce risks in existing soils to acceptable levels. Phosphate stabilization has been demonstrated in some studies to reduce bioavailability by as much as 50 percent, thereby reducing risks associated with contaminated soils, but the effectiveness of this technology under conditions at the FUZ site remains uncertain. Soil type and chemistry can be expected to impact the effectiveness of this type of technology. The long-term effectiveness and reliability of phosphate treatment is much less assured than the conventional approach of excavation and soil replacement.

Significant differences also exist between excavation and treatment with regard to management of untreated waste and treatment residuals. Excavation and replacement of contaminated soil requires final management of untreated waste in a disposal cell. If treatment is applied to contaminated properties, treated materials would remain at the surface in treated areas. Residual risks associated with direct contact with the treated soil would be reduced through the treatment process to acceptable levels. If the effectiveness of treatment decreased over time, residual risks of treated soil could increase to unacceptable levels. Long-term monitoring of treatment levels would be required to assure the continued effectiveness of the remedy.

The residual health hazard associated with excavated soil would be controlled through engineering controls by any of the final management options. Excavated soils placed in a solid waste landfill or a soil repository constructed for this purpose would be isolated from potential exposure as a result of placement inside a contained facility.

The FS estimated the net cost of yard excavation and soil replacement at $15,181 per property, compared to $41,567 per property for phosphate treatment. This demonstrates a considerable cost savings for Alternative 2.

Excavation and replacement of contaminated soils is the conventional approach to soil remediation from metals contamination and uses readily available equipment and standardized procedures. Removal and replacement of lead-contaminated soils is easily implementable and provides immediate protection and permanence by removing hazardous soils to prevent potential human exposure. By comparison, treatment of lead-contaminated residential soils uses an innovative technology for remediating a portion of the contaminated soils, and partially satisfies the CERCLA preference for treatment remedies. However, phosphate treatment has not been applied on a full-scale basis at sites similar to the FUZ site. Long-term effectiveness and reliability are uncertain with phosphate treatment, and significant short-term risks and implementation challenges exist for this alternative.

Expected Outcomes of Each Alternative

Both excavation of contaminated soils and successful implementation of phosphate treatment could allow for unrestricted future use of remediated properties. Residential use of these properties could continue under either approach. Both excavation and replacement of contaminated soils and soil treatment are readily implementable.

The time frame to achieve cleanup goals would be similar for both approaches. Excavation, soil replacement, and revegetation of a single property can be performed in a period of several days, but one to two weeks of implementation time is typical due to scheduling of contractors. By comparison, soil treatment could take from several days to a week for the soil additions to have their intended effects, after which soil neutralization and revegetation would be performed resulting in a typical implementation time of two to three weeks per property. Both approaches to site remediation will take a number of years to implement due to the large number of properties involved. Funding levels would control the number of properties that could be completed each year, which would control the project period. This analysis assumes that funding levels are sufficient to complete either Alternative 2 or Alternative 3 in a period of 1.5 years.

COMPARATIVE ANALYSIS OF ALTERNATIVES

In selecting a remedy for a site, the EPA considers the factors set forth in Section 121 of CERCLA, 42 U.S.C. § 9621, and conducts a detailed analysis of the viable remedial alternatives pursuant to Section 300.430(e)(9) of the NCP, 40 C.F.R § 300.430(e)(9); EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies, OSWER Directive 9355.3-01; and EPA's A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, OSWER 9200.1-23.P. The detailed analysis consists of an assessment of the individual alternatives against each of the nine evaluation criteria at 40 C.F.R. § 300.430(e)(9)(iii) and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

A comparative analysis of these alternatives based upon the nine evaluation criteria noted below follows.

Threshold Criteria *– The first two criteria are known as "threshold criteria" because they are the minimum requirements that each response measure must meet in order to be eligible for selection as a remedy.*

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Protection of human health and the environment is addressed to varying degrees by the two action alternatives, Alternatives 2 and 3. The No Action Alternative would have no effect on risks currently present at the Site and would not be protective of human health or the environment.

Alternatives 2 and 3 both provide protection of human health through reduced exposure to lead in contaminated soils. Alternative 3 provides protection through in situ treatment for soil lead levels between 400 ppm and 572 ppm by immobilizing lead and effectively reducing its bioavailability. Alternatives 2 and 3 provide protection by removal of contaminated soils from the exposure pathway and replacement with clean soil. The excavation activities address the risk of exposure through direct contact with lead-contaminated soil. ICs would provide further levels of risk reduction for Alternatives 2 and 3.

In general, the permanence of alternatives 2 and 3 is similar. Alternative 2 provides permanence through complete removal and containment of contaminated soils that exceed 400 ppm lead or 35 ppm arsenic. Alternative 3 provides permanence through immobilization of phosphate-treated contaminated soils and through removal and replacement of excavated soils. However, for Alternative 3 this determination would have to be supported by ongoing soil testing to determine if the treatment maintains its effectiveness over time.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121 (d) of CERCLA, 42 U.S.C. § 9621(d), and Section 300.430(f)(1)(ii)(B) of the NCP, 40 CFR §300.430(f)(1)(ii)(B), require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under Section 121(d)(4) of CERCLA.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

A complete list of ARARs can be found in Appendix A of the Feasibility Study (FS).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

A detailed evaluation of ARARs is presented in the FS. Alternatives 2 and 3 both meet the identified federal and Kansas ARARs. The No Action Alternative has no ARARs with which to comply.

Primary Balancing Criteria *– The next five criteria, criteria 3 through 7, are known as "primary balancing criteria". These criteria are factors by which tradeoffs between response measures are assessed so that the best options will be chosen, given site-specific data and conditions.*

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3. <u>Long-Term Effectiveness and Permanence</u>

Long-term Effectiveness and Permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

Long-term effectiveness assesses a cleanup alternative in terms of the risk remaining at the FUZ Site after the goals of the cleanup have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

Alternative 3 effectively reduces risks through a combination of treatment and soil replacement, while Alternative 2 achieves risk reduction through soil replacement only. Both Alternative 2 and successful application of Alternative 3 would provide long-term effectiveness for remediated properties. The residual risk is greater with Alternative 3 because the phosphate treatment component of this remedy leaves moderate levels of treated lead in yards with high mid-yard lead concentrations between 400 and 572 ppm. Alternatives 2 and 3 reduce risks for homes using effective engineering controls with soil concentrations of lead at or above 400 ppm. Alternatives 2 and 3 also include ICs to further control residual risks. The No Action Alternative provides no effectiveness for the protection of public health and the environment over the long term.

A long-term monitoring program would be required to assess the long-term effectiveness of phosphate stabilization under Alternative 3. The program would include soil chemistry monitoring, including bioaccessibility measurements to assess the effects of natural weathering and the long-term stability of the lead-phosphate minerals formed during phosphate treatment.

In general, permanence of the different alternatives for remediated properties is similar. Alternative 2 provides permanence through complete removal and containment of contaminated soils at or above 400 ppm lead concentrations. Alternative 3 provides permanence through a combination of soil treatment and removal and replacement of excavated soils.

4. Short-Term Effectiveness

Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents and the environment during implementation.

Alternative 2 involves removal and replacement of a greater quantity of soil, so risks to workers, residents, and community members associated with excavation and transport through residential neighborhoods would be somewhat greater than Alternative 3. Alternative 3 involves transporting and handling large quantities of phosphoric acid in residential areas, which poses additional risks to workers, residents, and community members.

Significant short-term risks are associated with Alternative 3. Contact with low pH soils must be prevented for a several-day period until soils are neutralized by adding lime. The low pH soils could potentially cause chemical burns or other adverse effects to individuals who come in contact with treated soils. Fencing installed to prevent access to treated areas would not assure protection of pets, small animals, birds, and other wildlife. Application of phosphoric acid to yards would pose short-term risks to workers involved in the handling and application of acid and roto-tilling of soils.

Alternatives 2 and 3 would require a similar length of time to implement at each residence. The No Action Alternative imposes no risk to remedial action workers, but the public and the environment would continue to be exposed to current lead levels.

5. Reduction of Toxicity, Mobility or Volume through Treatment

Reduction in Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment and the amount of contamination present.

Since the No Action Alternative does not involve any treatment, it would not reduce toxicity, mobility, or volume of site contaminants. Alternative 2 and the excavation component of Alternative 3 do not involve treatment, but would significantly reduce the mobility of the contaminated surface soils during final management due to the engineering features designed to contain the contaminated soils in a soil repository or secure landfill.

Alternative 3 would reduce the toxicity and mobility of contaminants in soil ranging in lead concentration from 400 to 572 ppm through chemical treatment. Phosphate stabilization under Alternative 3 uses treatment as a principle element of the cleanup, which is preferred under the Superfund law and the NCP. Phosphate stabilization transforms the lead in contaminated soils into a form that is less leachable and less bioavailable. The reduced leachability reduces the mobility of the lead in the environment. The reduced bioavailability lowers the toxicity of site contaminants to exposed individuals.

Excavation and replacement of contaminated soils reduces the mobility of contaminants in residual soils that remain in excavated areas of individual properties by providing a clean soil barrier above the exposed surface of the excavation. This barrier provides physical protection against migration of residual contaminants through erosion or other forces. Soils treated in Alternative 3 remain at the surface and are not afforded this same protection against potential migration.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

All alternatives are readily implementable. Excavation, backfilling, sodding or seeding, and material transportation are proven and easily implemented technologies. Excavation and replacement of contaminated soils is performed using conventional earth-moving equipment and hand tools, and can be readily performed by trained operators and laborers. Similar operations have been underway at the Site during previous CERCLA removal response actions. Coordination with local and state governments has been established.

The treatment portion of Alternative 3 would require additional planning to successfully implement. The procedures for soil treatment are anticipated to be straightforward and readily implementable. Application of phosphoric acid and lime to residential properties would utilize standard and readily available lawn maintenance equipment. Logistical considerations for transporting and staging large quantities of phosphoric acid and lime may present challenges in older residential neighborhoods at the Site, but these could be overcome with proper planning and equipment.

Soil treatment could offer potential implementation advantages relative to excavation and treatment at some properties. Soil excavation and replacement requires heavy equipment that must be transported in and out of residential neighborhoods. Residential properties often do not provide ready access for the types of equipment used to remove and replace soil, and much of the work must be performed by hand. Considerable damage can occur to residential properties through the use of heavy construction equipment even when care is taken to protect property features. Soil treatment typically utilizes smaller, more manageable equipment that is less likely to damage residential properties

Both action alternatives are considered technically feasible from an engineering perspective.

7. Cost

Cost includes estimated capital and annual operation and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent. (This is a standard assumption in accordance with EPA guidance.)

A detailed cost analysis for Alternatives 2 and 3 is presented in the FS. The total present worth cost for Alternative 2 is estimated at $19.8 million. The present worth cost for Alternative 3 is estimated at $36.0 million. Minimal costs are associated with the No Action Alternative.

Alternative 3 is more costly than Alternative 2 due in large part to the cost of the soil amendments required for phosphate treatment. A large increase in the cost of phosphoric acid has occurred since the initial investigation of this technology for potential application. Additional costs would also be incurred under Alternative 3 for the ongoing soil analysis program that would be required to assure the continued protectiveness of the remedy. The cost of phosphate treatment for an individual property is estimated at $41,567 in the Final Feasibility Study, compared to a unit cost of $15,181 per property for conventional excavation and soil replacement.

Modifying Criteria *– The final two evaluation criteria, criteria 8 and 9, are called "modifying criteria" because new information or comments from the state or the community on the Proposed Plan may modify the preferred response measure or cause another response measure to be considered.*

8. **State/Support Agency Acceptance**

State Agency acceptance considers whether the State and/or Support Agency agrees with the EPA's analyses and recommendations.

The EPA is the lead agency and has coordinated all Site activities with KDHE throughout this project. KDHE concurs with the selected remedy. A letter of concurrence is included in Appendix III.

9. **Community Acceptance**

Community Acceptance considers whether the local community agrees with the EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

On August 25, 2016, the EPA held a formal public meeting on the proposed plan for this OU. Approximately 50 people were in attendance, including a local resident and local, state and federal government officials. A transcript of the public meeting has been included in the AR. In general, the local community, including local citizens and officials, support the Selected Remedy (generally presented in the Proposed Plan as the Preferred Alternative).

Several questions were asked during the public meeting. Only one of these questions was left unanswered when the meeting ended. This question was:

> Have exposure levels been established for pets, livestock and poultry (pp. 20 and 28 of transcript)?

A Responsiveness Summary, which responds to this question and all others received during the comment period and captures public comments, has been included as part of this IROD.

PRINCIPAL THREAT WASTES

According to the Office of Solid Waste and Emergency Response, OSWER Directive 9380.3-06FS, A Guide to Principal Threat and Low Level Threat Wastes, dated November 1991:

> *Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.*

Based on this definition, contaminated residential soil does not appear to be a principal threat waste because it is not a source material and therefore does not require treatment. The locations of the former smelters at the Site are the ultimate source of the lead contamination in residential soil. These smelter locations are part of a separate operable unit (OU2) and will be addressed later under a future IROD. Additionally, the remaining lead-contaminated residential surface soil is neither highly toxic nor highly mobile in part because of previous removal actions.

However, the residual contamination found in residential surface soils can present significant risks to human health and the environment if not addressed, as discussed earlier. The Selected Remedy for OU1 allows the EPA to address the highest priority at the Site, which is human health risks posed by contaminated soils at residential properties.

SELECTED REMEDY

Summary of the Rationale for the Selected Remedy

The Selected Remedy for OU1 is Alternative 2 – Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls. The Selected Remedy was chosen over the other alternatives because, among other reasons, it will achieve the RAOs and provides the best balance of the available options with respect to the nine NCP criteria.

Alternative 2 is a continuation of the previous removal actions to excavate and replace lead-contaminated residential surface soil at the Site. The predicted long-term effectiveness of Alternative 2 is superior to Alternative 3 because the permanence of phosphate treatment is unknown. Bioavailability reduction from treatment may be temporary. The permanence of phosphate treatment must be verified before using it on a residential cleanup. In addition, it may be difficult to obtain community acceptance for residential phosphate treatment.

Alternative 2 is also better with respect to short-term effectiveness because soil disturbance activities will take less time at each property. Placing phosphate treatment materials on properties would require controls to protect residents and pets. With respect to implementability, Alternative 2 will be completed in a shorter time frame. Additionally, Alternative 2 is less costly than Alternative 3. The EPA has met the RAOs at other lead mine-related Superfund sites by employing alternatives similar to Alternative 2 with respect to the key components.

The goals of the ICs will be to prevent unnecessary disturbance of subsurface contamination and to ensure that lead safe practices are used when disturbance is necessary. The EPA will explore options with the local community to find the ICs which work best for OU1. The considered options include those listed in this IROD. However, these are mentioned as examples and are not intended to be a complete list.

The HHRA, which is the basis for the RAOs, clearly supports the need to take action at contaminated residential properties in a timely fashion. Construction will likely take a minimum of one and a half years to complete once implementation begins. This remedy was selected to eliminate exposure of residents (adult and child) to lead and arsenic in surface soil. Health education and ICs will assist in maintaining the protectiveness of the remedy once construction is completed and should continue in perpetuity in order to ensure the protectiveness of the remedy.

Description of the Selected Remedy

The EPA's selected remedy for OU1 of the FUZ site includes the following elements:

- soil excavation,
- soil disposal,
- vegetative cover,

- health education, and
- institutional controls.

The Selected Remedy was chosen by the EPA over the other alternatives based on the nine NCP criteria set forth above. The Selected Remedy provides the best balance of trade-offs between the nine criteria and achieves the RAOs.

Under this alternative, the definition of a residential property includes residential yards, public areas and child high-use areas. The EPA will continue to seek access to and complete sampling of all remaining residential properties that have not been sampled (estimated at 300) to determine the presence of lead contamination and eligibility for remediation. Approximately half of the 300 untested properties are projected to require remediation. If access is not granted by property owners to sample or remediate, other vehicles such as administrative action may be used to gain access.

A residential property with at least one quadrant testing greater than 400 ppm lead will be remediated. If the remaining drip zone of that property exceeds 400 ppm lead, the drip zone will also be remediated. A residential property with no quadrant exceeding 400 ppm lead will not be remediated under this action. A residential property with quadrants below 400 ppm lead but exceeding 35 ppm arsenic will be remediated.

Soil Excavation

Remediation under this alternative will include the excavation and disposal of lead- and arsenic-contaminated soil, backfilling the excavation with clean soil, and restoration of all disturbed areas of the property to its original condition. Soil will be excavated using equipment sized to match the property under excavation. This will minimize inconvenience for the property residents and their neighbors. Hand tools will be used in areas where access is constrained and to prevent damage to buried utilities, tree roots, plantings, landscaping and other structures.

Excavation will continue until the lead concentrations at the exposed surface are less than 400 ppm within the first 12 inches. Excavation will stop if lead levels are less than 1,200 ppm at depths of 12 to 24 inches. Should it be determined that lead levels below 1,200 ppm cannot be reached at an excavation depth of 24 inches, excavation will cease and a warning barrier will be placed to alert the property owner to the existence of high lead levels. Any garden areas will be excavated to a depth of 24 inches no matter what the lead concentration is at shallower depths.

Excavation will also be performed on the very few quadrants that have arsenic above 35 ppm while lead is below 400. It is unlikely that arsenic will remain above 35 ppm below the first 12 inches of excavation. Provided that lead remains below 400 at 12 inches, excavation will stop at 12 inches in this case. The EPA is confident that risk from arsenic contamination will be addressed by excavation of soil having more than 400 ppm lead. However, the EPA will continue to send ten percent of all property assessment samples for laboratory analysis. Any properties found with 35 ppm arsenic or more would be added to the list for cleanup.

The marker barrier will be an obvious, highly visible, plastic barrier that is permeable, wide meshed and will not affect soil hydrology or vegetation, such as an orange or red mesh plastic netting or construction fence. It will serve as a physical alert to anyone accessing the subsurface, indicating the presence of contaminated soil beneath it that poses a human health risk and should not be disturbed. The EPA recommends a minimum of 12 inches of clean soil be maintained at the surface to forever serve as an

adequate soil barrier to underlying soil that exceeds 400 ppm lead for protection of human health. The rationale for establishing this as a minimum thickness is that residents are most likely to come into contact with the top 12 inches of soil.

Soil Disposal and Vegetative Cover

The EPA plans to dispose of excavated soil at the Allen County landfill; however, more economical alternatives will also be explored. Soils that do not meet the TCLP threshold limit of 5 milligrams per liter for non-hazardous waste disposal for lead would be treated on site with a stabilization agent, and would then be resampled and analyzed for lead using TCLP analysis. This procedure would be repeated until the soils pass the lead TCLP threshold limit to allow soil to be disposed of as non-hazardous material at the landfill. After excavation and soil disposal, backfill will be placed and the property will be graded to its original condition. Clean fill and topsoil will be imported from an EPA-approved borrow source. The property will then be seeded and/or sodded to restore the vegetation.

Health Education

Health education is a component of Alternative 2 to reduce potential adverse health effects from lead contamination during the cleanup as well as after the cleanup is completed. Health Education measures considered for OU1 may include but are not limited to:

- in-home assessments for children identified with elevated blood lead levels;
- distribution of prevention information and literature;
- outreach activities directed to area physicians;
- community education meetings and distribution of literature at such places as civic clubs, schools, nurseries, preschools, churches, fairs;
- family assistance; and
- special projects to increase awareness of heavy metal health risks.

Health education options will be explored while the Selected Remedy is implemented. Options that are the most effective for this particular community will be chosen with the help of local stakeholders. These stakeholders include but are not limited to: Southeast Multi-County Health Department, Iola city officials as well as other agencies and individuals that have an interest in continuing health education.

Institutional Controls (ICs)

Alternative 2 includes ICs because contamination will remain below the ground surface at some properties. The EPA has historically required ICs to ensure a remedy's long-term protectiveness. At present, there are no applicable zoning ordinances in Allen County for residential properties. However, there are potential ICs that could be utilized. These may include but are not limited to the following:

- establishment of a registry of affected residential properties with the city of Iola or Southeast Kansas Multi-County Health Departments;
- yards subject to the ICs will also be extensively evaluated during each 5-year review completed by the EPA to ensure the remedy has remained protective;
- possible building permit requirements that would involve pre-screening properties for lead;
- builder and developer education programs for dealing with heavy metal soil contamination and best management practices for construction workers; and
- deed restrictions or environmental covenants.

IC options will be explored while the Selected Remedy is implemented. Options that are the most effective for this particular community will be chosen with the help of local stakeholders. These stakeholders include but are not limited to: Southeast Multi-County Health Department, Iola city officials as well as other agencies and individuals that have an interest in continuing to protect children's health in Iola, Kansas.

Summary of the Estimated Remedy Costs

The present worth cost for the Selected Remedy - Alternative 2 is estimated to be $19.8 million and is presented in Appendix D of the Feasibility Study. The estimate is based on inflation-adjusted expenses incurred by the EPA at similar residential lead sites. An inflation rate of 2.24 percent (average of 20 years of Engineering News Record Construction Cost Indices rounded to nearest hundredth of a percent) and a nominal discount (interest) rate of 5 percent (average of the available data for nominal 30-year treasury interest rates rounded to the nearest quarter of a percent) were applied separately in the determination of net present value.

This estimate is approximate and made without detailed engineering data. The information in Appendix D is based on the best available information regarding the anticipated scope of the Selected Remedy. Changes in the cost elements may occur as a result of new information and data collected during the implementation of the remedial action. Major changes, if they arise, would be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or an amendment to this IROD. This is an order-of-magnitude engineering cost estimate that is expected to be accurate within +50 to -30 percent of the actual project cost.

Expected Outcomes of the Selected Remedy

The Selected Remedy will provide an accelerated response to residential property surface soil contaminated with lead and arsenic above the cleanup level and will significantly improve human health protection in the community. Remediated properties will meet the cleanup criteria of less than 400 ppm lead and 35 ppm arsenic in surface soil based on the HHRA and RAOs. Implementation of the Selected Remedy will take an estimated one and a half years to complete, due to the large number of properties involved. The Selected Remedy at properties where barriers are placed at depth will be monitored via EPA five-year reviews and preserved under the IC management at a local level.

Continued residential use will be enabled at all remediated properties under the Selected Remedy. Land use may be enhanced because lead and arsenic-contaminated surface soil that would otherwise pose a human health risk will be excavated from the vast majority of residential properties. Residential properties with contamination left at depth will have a demarcation barrier in addition to a minimum 12-inch clean soil barrier. ICs will be in place to protect the surface and subsurface barriers. All remediated residential properties are expected to achieve unlimited use and unrestricted exposure with respect to the first 12 inches of soil.

STATUTORY DETERMINATIONS

The EPA expects the Selected Remedy to satisfy the following statutory requirement of section 121(b) of CERCLA: (1) be protective of human health and the environment, (2) comply with ARARs (or justify a waiver from such requirements), (3) be cost-effective, (4) use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and

(5) satisfy the preference for treatment as a principal element or explain why the preference for treatment will not be met. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy will protect human health and the environment at remediated residential properties by achieving the RAOs through conventional engineering measures, health education, and ICs. Risks associated with lead- and arsenic-contaminated residential soils at OU1 are caused by the potential for direct contact with contaminated soils. The Selected Remedy eliminates this direct exposure pathway through excavation and replacement of lead- and arsenic-contaminated soils at the residential properties. Contaminated soils will be removed from residential properties, permanently eliminating this identified source of exposure.

Health education will continue after implementation and will be part of the Operation and Maintenance (O&M) of the remedy. Health education will educate citizens, contractors and all other stakeholders, keeping them informed of the dangers of lead and methods of exposure prevention. The community will become aware that living with lead will always be a concern due to the widespread nature of lead contamination, but that living in the presence of lead contamination does not have to result in adverse health effects.

ICs will address contaminated soil that remains on site by placing the necessary controls in local hands to prevent recontamination of remediated properties and new contamination of residential properties from off-site source locations.

The selected remedy involves the excavation and transportation of contaminated soil. Disturbed contaminated soil could enter the ambient air during excavation and transportation activity. However, dust suppression techniques will be used during remedy implementation which will ensure that any risk is minimized.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The Selected Remedy is expected to comply with all action-specific, chemical-specific, and location-specific ARARs. A complete list of the ARARs, To Be Considered criteria and other guidance that concern the Selected Remedy is presented in Appendix A of the FS (attached).

There are no promulgated laws or standards for lead-contaminated soil. The cleanup levels of 400 ppm and 35 ppm for lead and arsenic have been calculated using site-specific information presented in the HHRA. The memo describing how the cleanup levels were determined is included in Appendix C of the FS (attached).

Excavation of properties would be performed in a manner to minimize the effect on historical landmarks at OU1 and would comply with the National Historic Preservation Act.

The RA would comply with requirements of the Clean Water Act. Storm water discharge permit requirements (National Pollutant Discharge Elimination System (NPDES) 40 CFR Parts 122-125) are not applicable to excavation of residential properties since excavation of residential properties would not disturb more than one acre. However, there may be larger areas such as parks and churches that must

comply with NPDES requirements, if the properties exceed one acre. Landfills, controlled fills, or repositories where the excavated soil is disposed would comply with the NPDES requirements.

Cost Effectiveness

The Selected Remedy is cost effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost effective if its costs are proportional to its overall effectiveness" (NCP 300.430[f][1][ii][D]). The chosen remedy relies on conventional engineering, construction and corrective action methods. Contaminated soils are removed and replaced, thereby providing a permanent remedy for remediated residential soils which should not be subject to future costs and in most cases provides for unrestricted use.

The estimated cost of Alternative 2 ($19.8M) is $16.2 million lower than Alternative 3 ($36M). In addition, the effectiveness of phosphate treatment depends on permanent reduction of bioavailability. If the reduction of bioavailability is not maintained, retreatment or excavation may be necessary. This would increase the actual cost of Alternative 3.

The excavation and replacement of contaminated surface soil in the Selected Remedy under Alternative 2 has the highest level of short- and long-term effectiveness and permanence of the alternatives evaluated.

Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The Selected Remedy relies on permanent solutions consisting of soil removal and replacement. The EPA has determined that the Selected Remedy provides the best balance of trade-offs with respect to the balancing criteria and bias against off-site treatment and disposal, and considering State and community acceptance. The Selected Remedy is reliable and cost effective. The constructed components will provide physical barriers to eliminate exposure to lead and arsenic, monitored under the ICs in conjunction with O&M to be provided by the KDHE. Short-term risks during construction can reasonably be controlled through best management practices such as watering for dust control, controlling precipitation runoff, and through construction site safety training of employees working under well-developed health and safety plans and required attendance at safety meetings.

Preference for Treatment as a Principal Element

The Selected Remedy does not utilize treatment to address the principle threats posed by the residential property soil; however, some of the contaminated soil may require treatment prior to disposal at an off-site facility. No treatment technologies were identified that have short- and long-term effectiveness, permanence, and meet the other NCP criteria. Phosphate treatment of contaminated soil considered in Alternative 3 is effective in the short term, but the long term effectiveness is unproven. The uncertain long term effectiveness makes phosphate treatment unsuitable for OU1. The selected remedy does not satisfy the statutory preference for treatment as a principal element due the lack of proven effectiveness and permanence of the treatment alternative evaluated. The selected remedy will reduce the mobility of contaminants of concern at the Site and control the potential for future exposure through removal and final management in a facility providing containment through engineering controls.

Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review is required. Five-year reviews are required after initiation of the remedial action to ensure that the remedy is or will be protective of human health and the environment in accordance with CERCLA 121(c) and the NCP at 40 CFR § 300.430(f)(5)(iii)(C).

DOCUMENTATION OF SIGNIFICANT CHANGES

The EPA reviewed all written and verbal comments submitted during the public comment period. One of the comments received noted that contamination of residential properties could be the result of atmospheric deposition, physical transport of contamination to the property, or both. The definition of OU1 has been revised to accommodate this comment.

The revised definition of OU1 is:

Residential and residential-type properties affected by contamination from former smelting operations, including atmospheric deposition and physical transport of contaminants. Only properties with one or more mid-yard samples with lead or arsenic concentrations above the site-specific, health-based cleanup goals will be part of the site.

GLOSSARY OF TERMS

This glossary defines many of the technical terms used in relation to the Former United Zinc and Associated Smelters site in this IROD. The terms and abbreviations contained in this glossary are often defined in the context of hazardous waste management and apply specifically to work performed under the Superfund program. Therefore, these terms may have other meanings when used in a different context.

Administrative Record (AR): All documents which the EPA considers or relies upon in selecting the response action at a Superfund site, culminating in the Interim Record of Decision for remedial action.

Baseline Human Health Risk Assessment (HHRA): A document that provides an evaluation of the potential threat to human health in the absence of any remedial action.

Bioavailability: A risk assessment term; the fraction of an ingested dose that crosses the gastrointestinal epithelium in the stomach and becomes available for distribution to internal target tissues and organs.

Blood lead level or concentration: The concentration of lead in the blood, measured in micrograms of lead per deciliter of blood (μg/dL).

Capital Cost: Direct (construction) and indirect (non-construction and overhead) costs including expenditures for equipment, labor and materials necessary to implement remedial actions.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The acts created a special tax that went into the Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, the EPA can either (1) pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work, or (2) take legal action to force parties responsible for site contamination to clean up the site or pay back the federal government for the cost of the cleanup.

Contaminant: Any physical, chemical, biological or radiological substance or matter that can have an adverse effect on human health or environmental receptors.

Contaminants of Potential Concern (COPC): A substance detected at a hazardous waste site that has the potential to affect receptors adversely due to its concentration, distribution and mode of toxicity.

Discount rate: A percentage rate used in present worth analyses to identify the cost of capital and operation and maintenance expenses. It is used to value a project using the concepts of the time-value of money where future cash flows are estimated and discounted to give them a present value.

Exposure pathways: The course a chemical or physical agent takes from a source to an exposed organism. Each exposure pathway includes a source or release from a source, an exposure point and an exposure route.

Feasibility Study (FS): A report that analyzes the practicability of potential remedial actions; that is, a description and analysis of potential cleanup alternatives for a site on the National Priorities List.

Groundwater: Water filling spaces between soil, sand, rock and gravel particles beneath the earth's surface, which often serves as a source of drinking water.

Interim Record of Decision (IROD): A public document that explains which cleanup alternative(s) will be used at a National Priorities List site.

National Contingency Plan (NCP): The federal regulation that guides the Superfund program.

National Priorities List (NPL): The EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System.

Operation and Maintenance (O&M): Activities conducted at a site after response actions occur to ensure that the cleanup or containment system continues to be effective.

Preliminary Remediation Goals: Site-specific concentration values set as cleanup targets based on known and projected human health and ecological risks.

Present worth: The amount of money necessary to secure the promise of future payment or series of payments at an assumed interest rate.

Proposed Plan: A plan for a site cleanup that is available to the public for comment which summarizes remedy alternatives and presents the EPA's Preferred Alternative or cleanup approach.

Remedial Action (RA): The actual construction or implementation phase of a Superfund site cleanup.

Remedial Investigation (RI): An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site, establish site cleanup criteria, and support technical and cost analyses of alternatives. The RI is usually done with the feasibility study. Together they are usually referred to as the RI/FS.

Removal action: Short-term immediate action taken to address releases of hazardous substances that require an expedited response.

Responsiveness Summary: A summary of oral and/or written public comments received by the EPA during a comment period on key EPA documents and the EPA's response to those comments.

Toxicity: The degree to which a chemical substance (or physical agent) elicits a deleterious or adverse effect upon the biological system of an organism exposed to the substance over a designated time period.

RESPONSIVENESS SUMMARY FOR THE INTERM RECORD OF DECISION

Former United Zinc and Associated Smelters
OPERABLE UNIT 01
Allen County, Kansas

This Responsiveness Summary has been prepared in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act, and the National Contingency Plan, 40 CFR § 300.430(f). This document provides the U.S. Environmental Protection Agency's response to all significant comments received from the public on the Proposed Plan for the Former United Zinc OU1 Site during the comment period.

The Responsiveness Summary consists of two components: Stakeholder Comments and Potentially Responsible Party Comments.

Stakeholder Comments

Several verbal questions from persons attending the public meeting were received. With one exception, these questions were answered during the meeting. Details on these questions and the answers provided can be found in the transcript.

One question during the public meeting required additional research before it could be answered. This comment asked about the effect contamination would have on animals, particularly pets and livestock; the response is provided below.

The following is a summary of all questions from the public meeting transcript. Each is followed by the answer provided at the meeting which is also in the transcript.

Mr. John Cox asked for clarification of the web address for the Administrative Record (AR).
Answer: The web address for the AR is:

https://semspub.epa.gov/src/collection/07/AR63756

An unidentified person asked if using agricultural lime would reduce the risk posed by lead in residential soil.
Answer: This question was answered during the meeting. Lime contains calcium which is preferentially absorbed by the body when compared to lead. Mixing soil with lime would reduce the risk of lead somewhat. However, this benefit would be temporary and would last until the calcium dissipated over time. The EPA does not consider remedies that are not long-lasting.

Ms. Patricia Fail asked if the EPA has exposure levels for pets and livestock.
Answer: The answer to this question was researched and the commenter was informed that a response would be provided in this responsiveness summary. The EPA's risk assessors used the data to calculate the risk to domestic animals. The results of these calculations show that unsafe lead levels for domestic animals range from 3,800 to 5,000 ppm. Therefore, the chosen cleanup level for lead, 400 ppm, will be protective of animals as well as humans.

Ms. Patricia Fail asked if the phosphate mentioned in the treatment alternative would be beneficial to plants.
Answer: Yes. The phosphoric acid used under Alternative 3 does promote plant growth.

Ms. Cynthia Jacobson asked if the EPA has published a list of tested properties or a map showing the properties that have been tested.
Answer: Yes. Maps showing the results of soil sampling appear in the Remedial Investigation report. This report is part of the AR. However, a written list has not been published.

Mr. Richard Lukin asked if the EPA would require owners to give the EPA access to their property if they do not grant it voluntarily.
Answer: The EPA has successfully convinced property owners to grant access to their property voluntarily and the need to consider compelling access has not arisen. The EPA will consider the possibility of requiring access if the voluntary strategy is not fully successful.

Ms. Patricia Fail asked how many properties were above the limit.
Answer: The EPA estimates that there are approximately 900 properties above the proposed cleanup level of 400. Approximately 350 of these exceed 800 ppm and are being addressed under the ongoing removal action. Approximately 550 properties with contamination between 400 and 800 ppm will remain when the removal action ends. These properties will be addressed under the remedial action.

Mr. Koontz asked how the Former United Zinc site was brought to the attention of the EPA.
Answer: KDHE submitted a September 2005 Preliminary Site Removal Evaluation report to the EPA. This report stated "... it appears especially lead, as well as arsenic, cadmium, and zinc, are present at elevated levels within residential and non-residential properties within the site area...."
The EPA began sampling properties on or about April 11, 2006, based on information in the KDHE report.

Mr. Koontz asked if there was a reason for the time lag between the end of the first removal action in 2007 and the beginning of the Remedial Investigation sampling in 2013.
Answer: The removal action ended in 2007 when the EPA reached a statutory $2 million limit on removal actions. The EPA began the process of listing the site on the National Priorities List shortly thereafter. Considerable effort is required to develop the documentation needed to propose a site for the NPL. Once proposed, the public is invited to comment during the public comment period. Answers to these comments are published in the Federal Register along with the final decision to list the site. This process took some time to complete.

Ms. Sharon Boan asked how the EPA would determine which properties would be treated with phosphate.
Answer: The EPA explored the possibility of using phosphate treatment. However, phosphate treatment was not part of the selected remedy.

Ms. Linda Whitworth-Reed, pastor at the Presbyterian Church, complimented the professionalism of the EPA's crew who worked on the church parsonage.

Mr. David Toland asked about the EPA's plans for remediating properties that are not residential. In particular, he wanted to know what would be done about the property where the United Zinc smelter was located.

Answer: The EPA will start working on the commercial properties where the United Zinc, East Iola and Lanyon 1 & 2 (now known as the IMP Boats property) smelters were located when the residential remedial action is complete. Parts of these properties have already been redeveloped by private companies under the state of Kansas Voluntary Cleanup Program. These parcels have already been made safe for use and are not part of the Superfund site.

Mr. Hoffmeier asked about details related to the Kansas Voluntary Cleanup Program. Specifically, he wanted to confirm his understanding that costs related to redevelopment of the medical clinic were paid by the developer.
Answer: Yes. Several property parcels of the East Iola and United Zinc smelter properties have been redeveloped under the Kansas Voluntary Cleanup Program. The medical clinic is one of these parcels. Costs for redevelopment are paid by the developer, not the EPA.
The EPA would be willing to work with other developers interested in the undeveloped parcels that remain. These parcels would be added to the Voluntary Cleanup Program and work would be supervised by the state of Kansas.

Ms. Deborah Smail asked if property owners will receive written certification from the EPA stating that the property was cleaned up.
Answer: Yes. The EPA will send a letter to owners of properties that will document the cleanup performed on their property. The letter will include a sketch that will show where cleanup was performed.

Ms. Deborah Smail asked if the completion letter would be needed for future sale of the property.
Answer: Yes. In the event you sell or lease the property, this letter is considered a record under Section 1018 of the Residential Lead-Based Paint Hazard Reduction Act of 1992, 42 U.S.C. 4851 et seq. and must be disclosed.

Mr. Carl Slaugh asked if EPA has made a list of property soil test results available to the general public.
Answer: A registry of property soil test results has not been developed yet. However, a registry is part of the preferred remedy for the site. The EPA envisions the registry as a complete list of all residential properties at the site. The list will include soil test results and the date when cleanup was completed. Properties that have not been sampled will also be included in the registry. In the future, the registry will become a valuable resource for the real estate community.

Mr. Carl Slaugh asked if the EPA has required owners to give the EPA access for testing or cleanup.
Answer: See earlier response to Mr. Richard Lukin.

Mr. Carl Slaugh asked about similar Superfund sites with lead contamination. He asked if those refusing the cleanup offered by the EPA were later required to perform the cleanup at their own expense.
Answer: The EPA encounters property owners who have refused the cleanup on rare occasions. The EPA makes repeated attempts to convince the owner to allow cleanup. Being informed that the owner's property will appear in the registry as a contaminated property that was not cleaned up often changes the owner's mind. The EPA has not, however, required owners to perform cleanups at their own expense.

Ms. Joanne Michael asked about the Superfund five-year review process in relation to an asphalt cap such as a driveway or parking lot.
Answer: Superfund performs a review every five years at all sites where contamination remains to ensure that the remedy implemented is still protective of human health and the environment. For

example, asphalt that caps contamination beneath it would be checked every five years to ensure that it still functions as a barrier between the contamination and the surface.

Ms. Martha Day asked where contaminated soil is disposed after it has been excavated.
Answer: The contaminated soil is sent to the Allen County Landfill and covered with clean soil.

The EPA received a comment from Ms. Julie Aubert during the comment period. She said that properties above 800 ppm should be cleaned up before properties with lower lead concentrations.
Answer: This is how the EPA approaches all lead cleanups. Properties contaminated at levels above 800 ppm are currently being addressed under the ongoing removal action. The proposed remedy will address properties 400 ppm and above. Properties that remain above 800 when the remedial action begins, if any, will be given priority.

Potentially Responsible Party Comments

An October 6, 2016, letter from Cypress Amax was received during the comment period. Responses to these comments are numbered to match the numbering scheme in the letter. Therefore, the numbering will begin anew starting with the Specific Comments on the RI Site Background Narrative.

Response to General Comments

1. EPA's asserted smelter aerial deposition theory

This comment requested additional detail about why the EPA believes lead from the smelters was deposited on the surface of residential properties.

Section 4 of the Remedial Investigation report describes the nature and extent of contamination in detail. Lead and arsenic contamination is found at high concentrations on the former smelter properties. Lead and arsenic are also found above natural background in the surface soil of nearly all residential properties. Cadmium, zinc, barium, copper and silver are also frequently found above the site-specific background on residential properties.

Metals smelting is an inherently messy process. In addition to zinc, zinc ore typically contains arsenic, cadmium, calcium, copper, fluorine, iron, lead, manganese, mercury, silica and sulfur. Dust, fumes, and gases containing various combinations of these materials are generated at zinc smelting facilities by mechanical and pyrometallurgical processes that convert ore and concentrates into marketable zinc products and byproducts.[6]

The figures labeled Plate 5 through Plate 14 (Appendix I) provide visual representation of the wide distribution of lead, cadmium, zinc, barium, copper and silver. There seems no other way for these metals to be found together above natural background other than particulate releases from smelter smokestacks. A photograph from the Allen County Museum showing smokestacks can be found in Appendix A of the RI report.

[6] p. 1, Historical Zinc Smelting in New Jersey, Pennsylvania, Virginia, West Virginia, and Washington, D.C., with Estimates of Atmospheric Zinc Emissions and Other Materials, by Donald L. Bleiwas and Carl DiFrancesco, 2010.

The Isoconcentration map (Plate 6, Appendix I) shows the former smelter locations with the highest concentrations of lead. Surrounding these two hot spots are properties with lead levels that are well above background. This type of pattern is what would be expected when contamination is released to the atmosphere from point locations. The contaminants would travel with the wind until they settled on the ground below.

Section 4.9 summarizes the Speciation and Bioavailability Study Report which is included in the RI as Appendix N. The study does acknowledge that lead-based paint contributes to the overall lead concentration in residential soil. However, the speciation report states that at least 31% of residential lead contamination is from pyrometallurgical sources. Yards also have been impacted by lead-bearing paint, but on a limited basis.

Only one mechanism of transport from the smelters to residential properties could have contaminated nearly all residences in the city of Iola. This is air deposition of particulate matter released from smelter stacks. Previous removal actions at highly contaminated properties have sometimes revealed that waste material from the smelters has been used as fill material. But this fill material is covered with top soil that will support grass.

Gases from smelting processes are hot and contain concentrations of pollutants that would be toxic if inhaled. Smoke stacks are meant to conduct waste gases safely from the ground to a height well above people working on the ground. Considering that the period of operation of the smelters was between the late 1800s and the early 1920s, it is unlikely that the stacks had any air pollution control equipment. This means that all of the smelters released considerable amounts of particulate matter at a high elevation. These particulates were transported by the wind and eventually settled on the ground below which is now the city of Iola.

The timeframe of smelter operation, the late 1800s to early 1920s, is also notable because it establishes the type of process used to purify zinc at the time. The process used horizontal retorts arranged in racks which were heated with a furnace. The process is labor intensive (because of the batchwise nature of retorts); it is energy inefficient (about 5 percent efficiency); it is inefficient in zinc recovery (about 10 percent of the zinc remains in the retort residue); and it is very bad from an air pollution standpoint ("blue powder" or flue dust production is high).[7]

Soil sampling for the RI was designed to identify areas where contaminated soil could be a human exposure pathway. Most of the soil samples were collected within one inch of the ground surface. A few depth samples were collected (see section 4.4.1 of the RI) to determine the subsurface profile of contamination. These depth samples show that concentrations of lead generally decrease with increasing depth. This trend would be expected when contamination is from atmospheric deposition (see Section 6.3.1 of the RI). However, the EPA realizes that smelter waste has been used for fill purposes at some residential properties.

Removal actions performed by the EPA have found properties where smelter waste was used for fill below the surface. This fill material was excavated along with the contaminated soil since it could pose a risk if the homeowner digs below the surface in the future. However, removing the subsurface smelter waste was incidental to the surface contamination cleanup.

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[7] p. 46 Technical and Microeconomic Analysis of Cadmium and its Compounds, EPA, June 1975.

Since smelter waste is sometimes cleaned up along with contaminated surface soil, the EPA agrees that the definition of OU1 should be modified to include smelter waste found at residential properties. The revised definition of OU1 is:

Residential and residential-type properties affected by contamination from former smelting operations, including atmospheric deposition and physical transport of contaminants. Only properties with one or more mid-yard samples with lead or arsenic concentrations above the site-specific, health-based cleanup goals will be part of the site.

2. Other asserted source pathway theories

This comment asks for additional description of the impact of surface water runoff from smelter locations on residential properties.

The pathways of surface water drainage from the smelter locations are generally away from residential properties. The United Zinc, East Iola and Coberly properties are all on the east edge of town and the surface grade slopes further east and south, carrying runoff farther from town toward Rock Creek (see Figure 2.2a of the RI). The IMP Boats property is on the west edge of town and the surface grade slopes further west and south, carrying runoff farther from town toward the Neosho River (see Figure 2.2.b of the RI).

The impact of smelter runoff on residential properties is predicted to be minor compared to aerial deposition. However, the remedy for OU1 will address all surface contamination at residential properties regardless of how much of it was transported to the residence by runoff.

The smelter and the Coberly properties are defined as OU2 of the site. The uncontrolled surface contamination at OU2 could recontaminate some residences over time if left unaddressed. The EPA plans to address OU2 after the remedy for OU1 has been completed.

3. Definition of OU1

This comment requests the definition of OU1 be modified.

The EPA made this modification.

Specific Comments on the RI Site Background Narrative

The EPA has revised the language regarding the IMP Boats Property, the East Iola Property and the East Iola Source Property in response to the comments provided by the commenter on these properties. Also, the RI was updated to accommodate these changes.

Specific Comments on the Source Attribution

1. Differentiation among sources of lead at residential properties

This comment is related to the narrow definition of OU1 in the SITE BACKGROUND section of the proposed plan. The first sentence in this section states:

"Residential-type properties that are contaminated with lead and arsenic resulting from historic industrial emissions are the only type of properties that will be addressed by this cleanup."

This statement was not intended to be interpreted absolutely, excluding all other contributing sources. The EPA believes that all properties in Iola received some contamination that was originally released from the smelters' smokestacks during the time of their operation. The Speciation and Bioavailability Study Report in Appendix N confirms this.

The total metals concentration of any soil sample is a combination of background concentrations, deposition from smelter smokestacks, and flaking paint as well as other anthropomorphic sources. Soil sampling done by the EPA measures total metals concentrations. It does not, and was not intended to, precisely identify the sources that contributed to the total metals concentration in each soil sample.

It is true that flaking lead-based paint can contribute to lead concentrations away from the drip zone. However, as mentioned previously, contamination from smelter smokestacks has been deposited on all Iola residential properties. People are exposed to the comingled contamination. Therefore, the cleanup goals are based on total concentrations, not the individual contribution of a particular source.

The EPA realizes that flaking lead-based paint contributes to the total lead concentrations in residential soil. A drip zone sample from soil immediately surrounding the foundation is collected from every residence. Occasionally the drip zone will be the only part of the yard that is above the cleanup goal. All samples from the property will still have some lead from smokestack deposition. But in this situation, the contribution by flaking paint may be responsible for raising the concentration above the cleanup goal. In these cases, the EPA believes it may not have authority to perform a cleanup since most of the lead is likely to be from flaking paint.

2. This comment questions why residences were not evaluated for the presence of lead-based paint, including sampling indoor house dust.

The Project Objectives in the Sampling and Analysis Plan include screening the interior and exterior of residences for lead-based paint. When the SAP was drafted it was thought that this information was needed to support the HHRA. The EPA's risk assessor reviewed the SAP and determined that collecting interior and exterior paint samples would not help with developing a site-specific cleanup goal. Therefore, this information was not collected. The SAP Project Objectives were not updated to reflect this change.

The information was not intended to be used to apportion responsibility for contamination.

3. This comment has several parts, all related to source attribution.

   Section 4.2 Source Area Soil Analytical Results of the RI was intended to present the results of samples collected from the smelter and Coberly locations. Source attribution was not the primary goal of the RI sampling performed in 2013. However, attribution was considered in the Speciation and Bioavailability Study Report which is Appendix N of the RI report.

   a. There is no discussion of how high metals concentrations at the source areas (OU2) are related to the contamination in residential properties (OU1).

Section 4.2 of the RI report summarizes the contamination found at the surface of source area properties. Lead contamination up to 20,700 ppm can be found at the surface of these properties which were once used for metals smelting. This confirms that smelting performed at these Iola properties left significant contamination behind. As mentioned previously, much of the contamination from the smelters was released by the smokestacks. Particulates from these releases subsequently landed on residential property.

b. There is no discussion of how "site related mining metals" at off-site properties are related to the source areas.

"Site related mining metals" at the site refers to metals contamination from the processes used to purify metals from ore that was mined. The EPA acknowledges that other sources of lead contribute to the total concentrations in residential soil. However, the high lead concentrations together with the elevated levels of other metals at residential properties indicate that smelting releases play a large role in the overall contamination in Iola.

c. The phrase "little lead paint" which appears on page 31 of the Speciation and Bioavailability Study (Appendix N of the RI) needs further explanation.

This statement occurs in a discussion about how to attribute lead in the form of cerrusite (i e., lead carbonate - $PbCO_3$). Since cerrusite could be from either anthropogenic (e.g., paint) or pyrometallurgical sources, the researcher used the proportion of lead definitely from paint as well as the particle size of the cerrusite to divide the contribution of lead between soil-forming[8] and non-specific sources. The phrase was not intended to suggest that paint was rarely found in residential samples.

d. The drip zone sample collected from each residential property does not fully measure the contribution of flaking lead-based paint.

Yes. The drip zone sample was not collected to fully apportion the contribution of lead paint to the overall contamination profile at a residence.

e. Too few depth samples were collected from residences to properly attribute the contribution of imported waste used for fill on soil away from the foundation. Also, there is no discussion of how the depth sample results support the belief that the smelters were the source of contamination at residences.

As previously mentioned, depth samples were collected to estimate the depth profile of contamination. They were not meant to determine how many properties had smelter waste imported for fill purposes. Imported waste used for fill is likely to have little impact on surface contamination since properties with fill are usually capped with soil that supports the growth of grass and shrubs. Waste fill encountered during previous removal work has generally been located unmixed beneath the surface.

[8] Soil-forming lead phases are those that are formed by adsorbing lead from soluble forms that are breaking down in the soil environment. These lead-containing compounds form over time after lead has been released to the soil. Once lead has been converted to soil forming phases, it is not possible to distinguish between lead paint or pyrometallurgical sources.

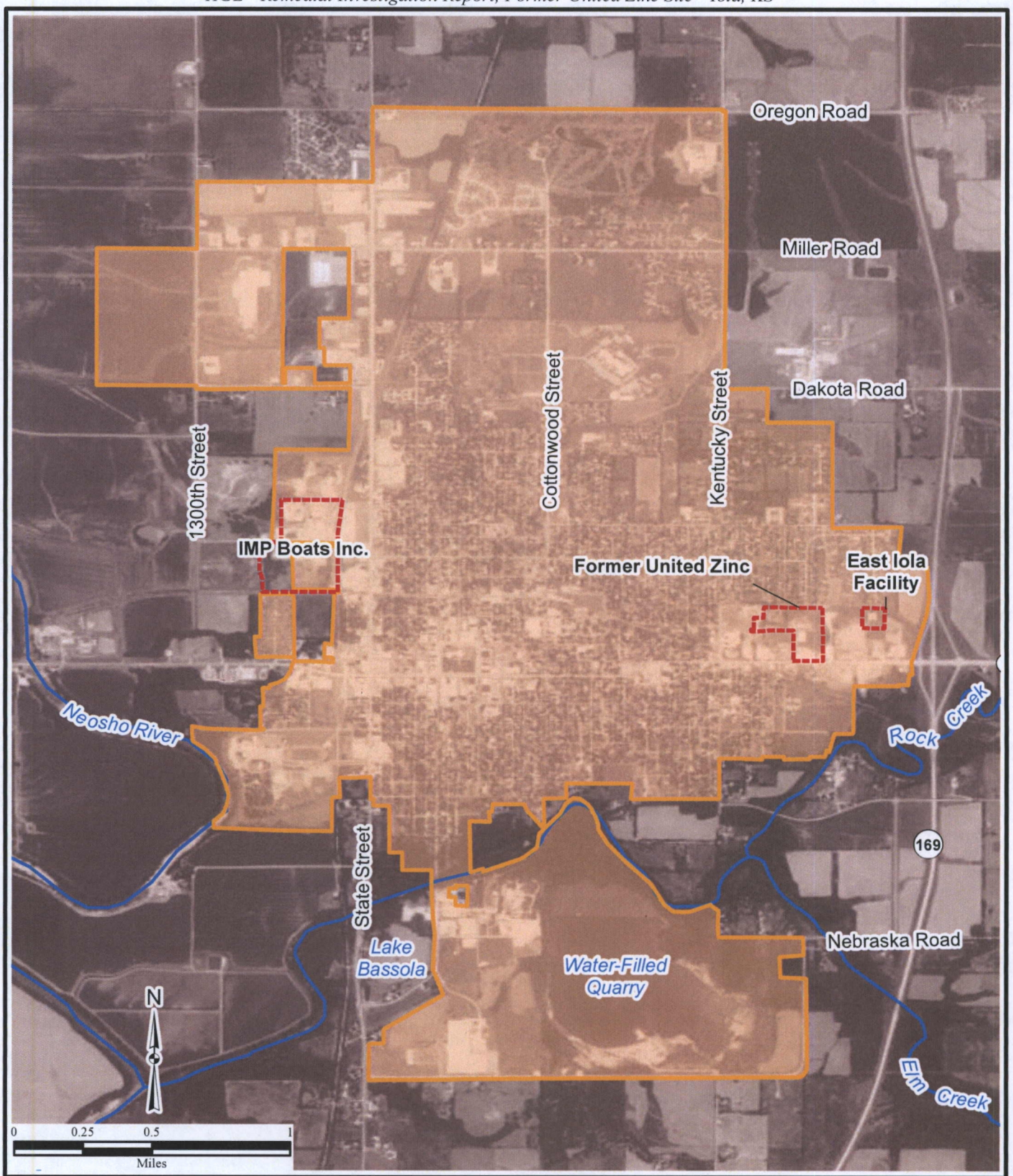
f. The decision not to collect indoor dust samples eliminated a line of evidence that could have been used to evaluate the contribution of lead paint to total residential lead contamination.

The Project Objectives of the Sampling and Analysis Plan includes the collection of indoor dust from residences. When the SAP was drafted it was thought that this information was needed to support the HHRA. The EPA's risk assessor reviewed the SAP and determined that collecting interior and exterior paint screening would not help with developing a site-specific cleanup goal. Therefore, this information was not collected. The SAP was not updated to reflect this change.

The information was not intended to be used to apportion responsibility for contamination.

APPENDIX I

FIGURES



\\Gst-srv-01\hglgis\United_Zinc_MSIW\2015_RI_Report\(1-02)Iola_Loc.mxd
5/5/2016 JG
Source: HGL, ESRI, ArcGIS Online Imagery

Legend

- Surface Water Course
- Former Smelter
- Iola City Limits

Figure 1.2
Former Smelter Locations

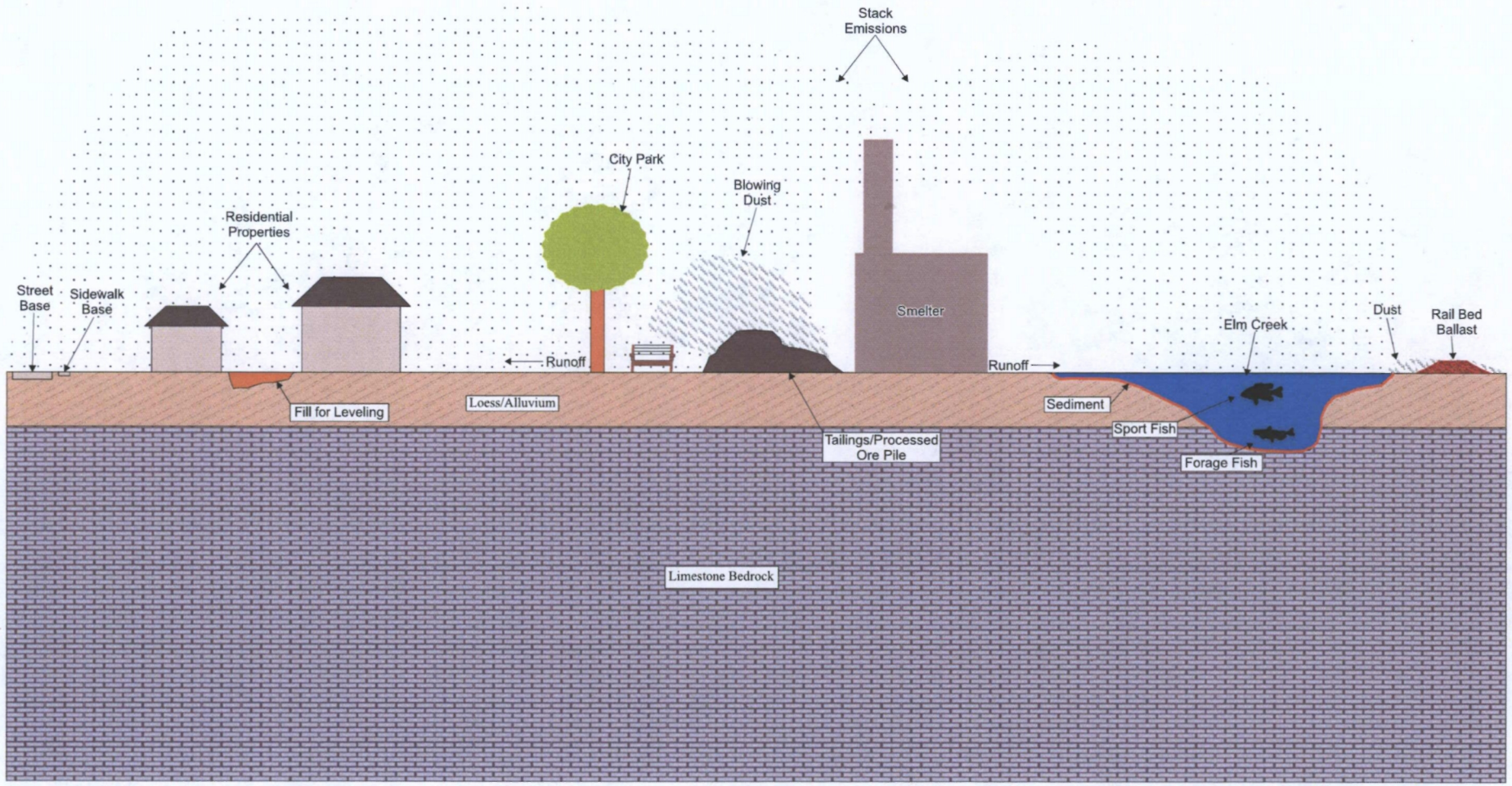


Figure Not to Scale

\\Gst-srv-01\hglgis\United_Zinc_MSIW\Draft_FS (2-03)Site_Conceptual_Model2.cdr
6/29/2016 JG
Source: HGL

Figure 2.3
Conceptual Site Model

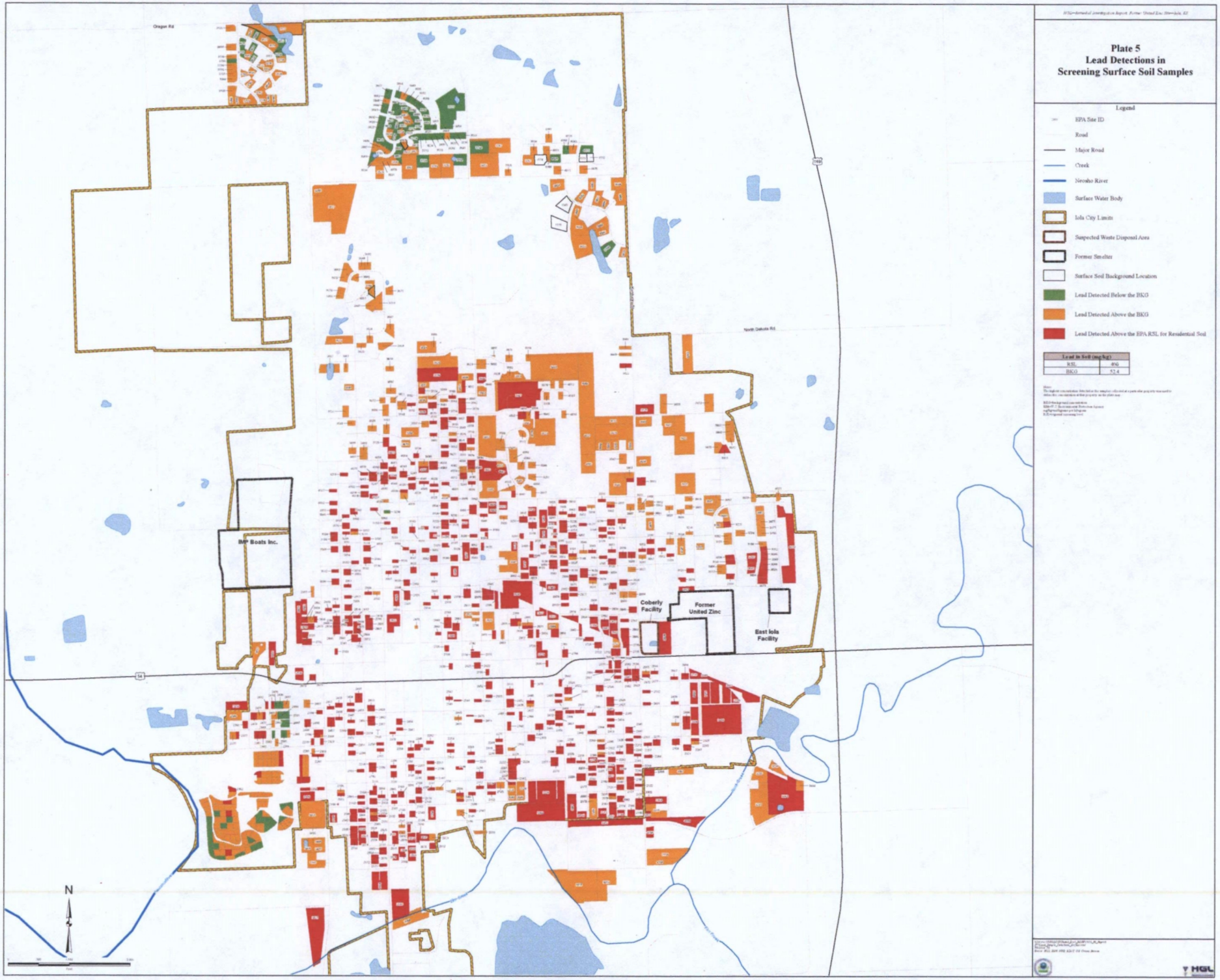


Plate 5
Lead Detections in Screening Surface Soil Samples

Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location
- Lead Detected Below the BKG
- Lead Detected Above the BKG
- Lead Detected Above the EPA RSL for Residential Soil

Lead in Soil (mg/kg)	
RSL	400
BKG	52.4

Notes:

BKG=background concentration
RSL=U.S. Environmental Protection Agency
mg/kg=milligrams per kilogram
U.S.=United States

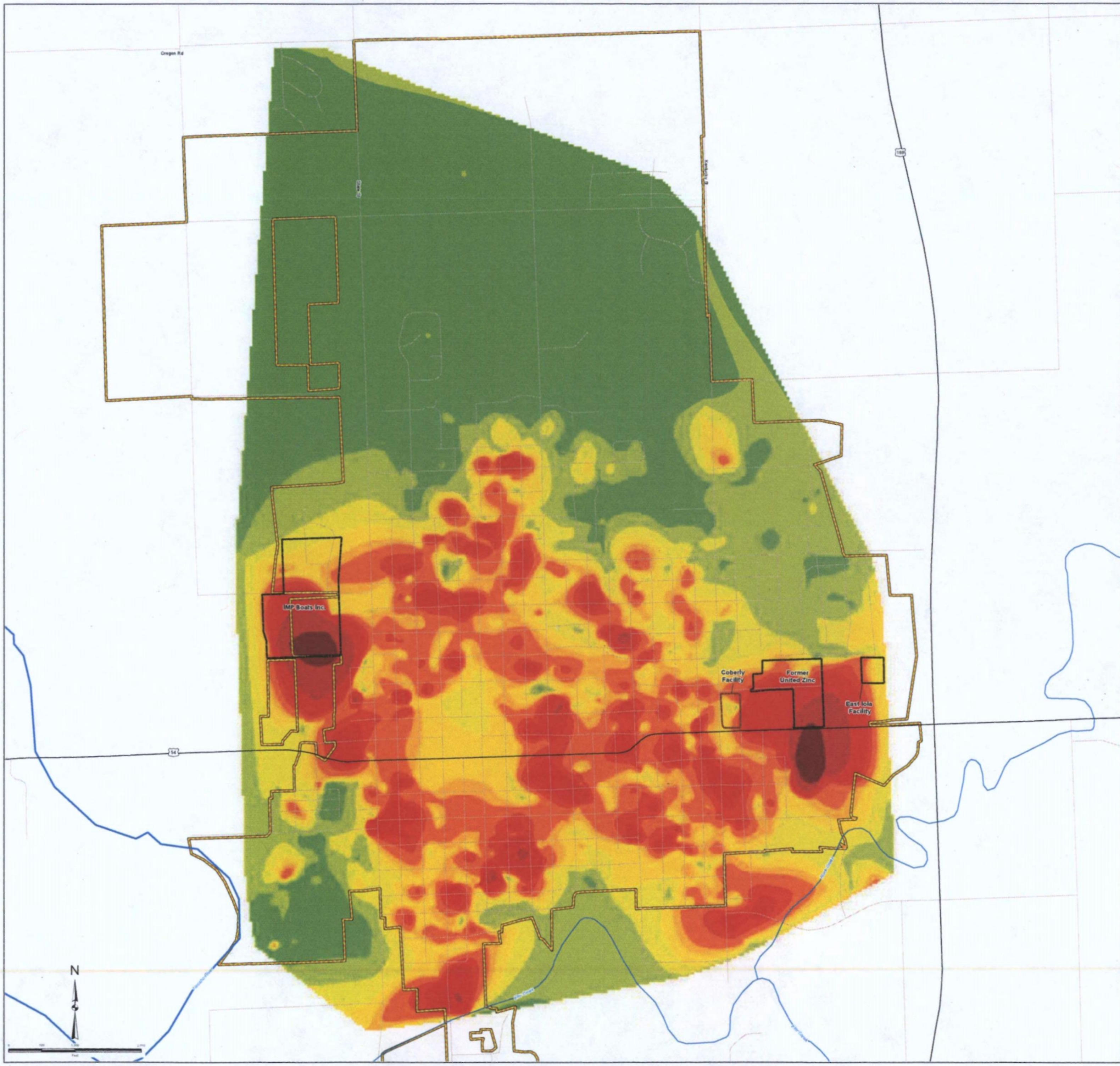


Plate 6
Lead Isoconcentrations in Screening Surface Soil Samples

Legend

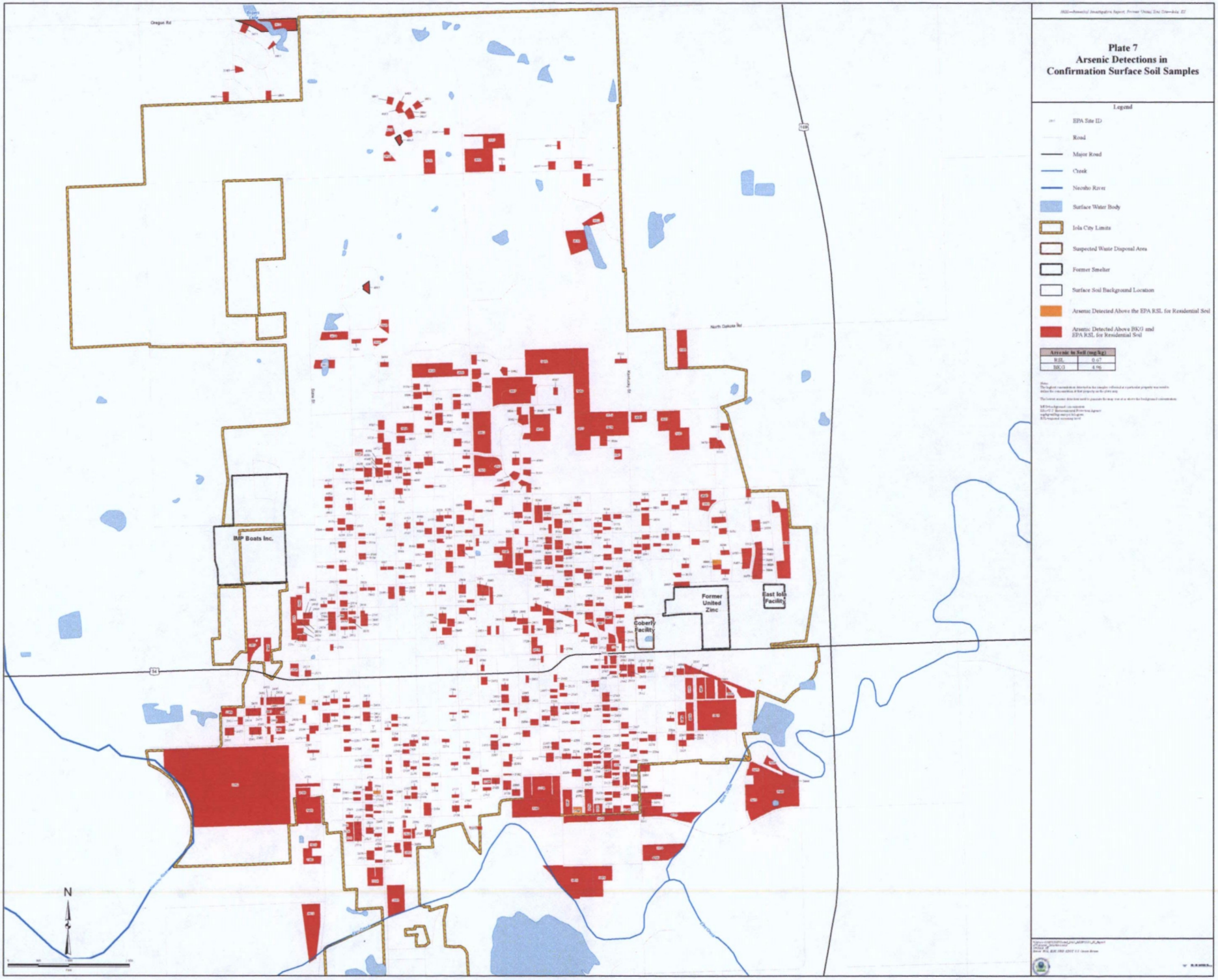
- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter

Lead Isoconcentration (mg/kg)

- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1,000
- 1,001 - 1,500
- 1,501 - 2,000
- 2,001 - 5,000
- 5,001 - 15,000
- 15,001 - 65,000

HGL

Plate 7
Arsenic Detections in Confirmation Surface Soil Samples



Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location
- Arsenic Detected Above the EPA RSL for Residential Soil
- Arsenic Detected Above BKG and EPA RSL for Residential Soil

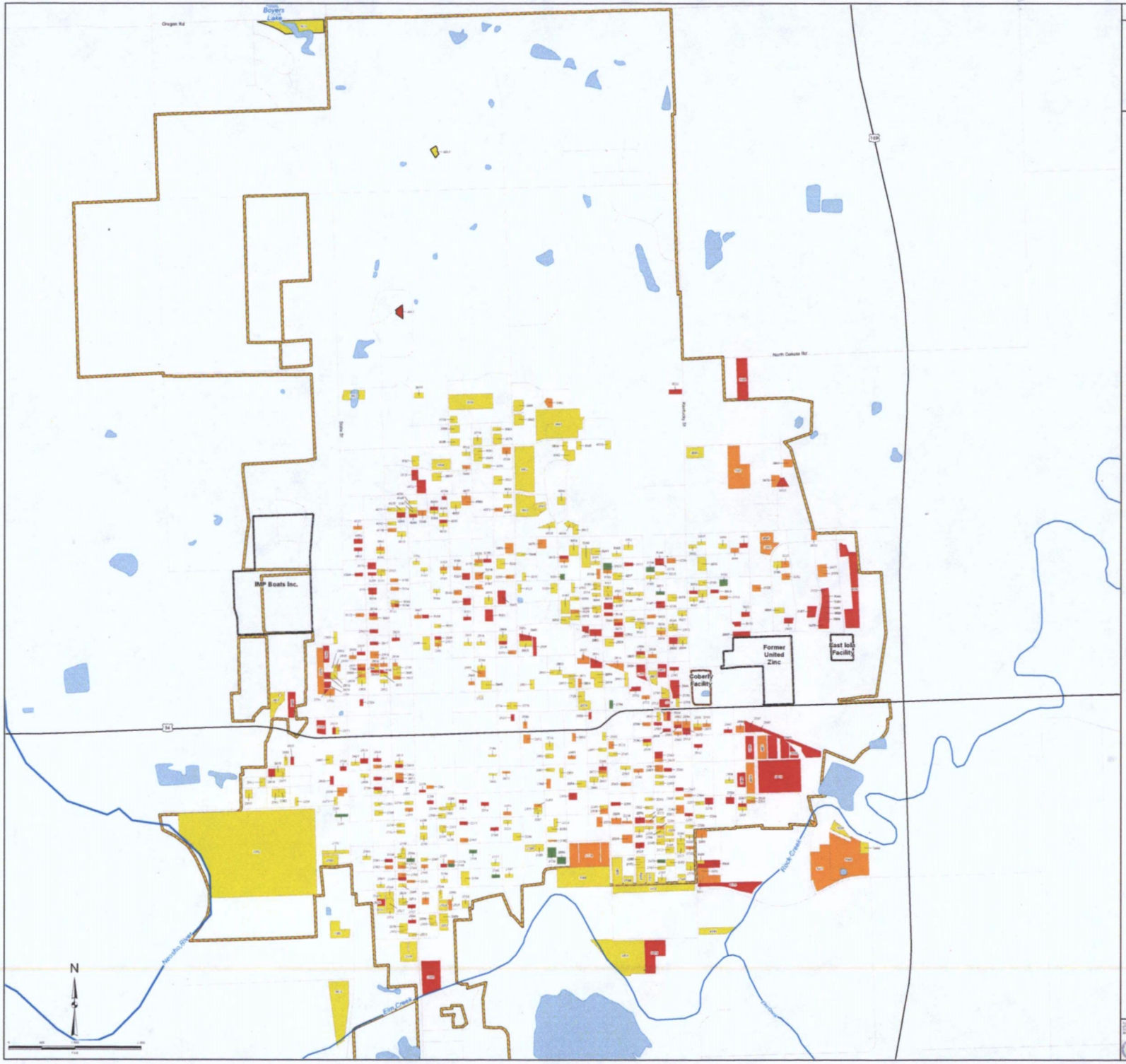
Arsenic in Soil (mg/kg)	
RSL	0.67
BKG	4.96

Note:
The highest concentration detected in the sample collected at a particular property was used to define the concentration at that property on the plate map.

The lowest arsenic detection used to generate the map was at or above the background concentration.

BKG=background concentration
EPA=U.S. Environmental Protection Agency
mg/kg=milligrams per kilogram
RSL=regional screening level

Plate 8
Cadmium Detections in Confirmation Surface Soil Samples



Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location
- Nondetect at the Assigned Reporting Limit
- Cadmium Detected Below the BKG
- Cadmium Detected Above the BKG
- Cadmium Detected Above the EPA RSL for Residential Soil

Cadmium in Soil (mg/kg)	
RSL	7
BKG	4.9

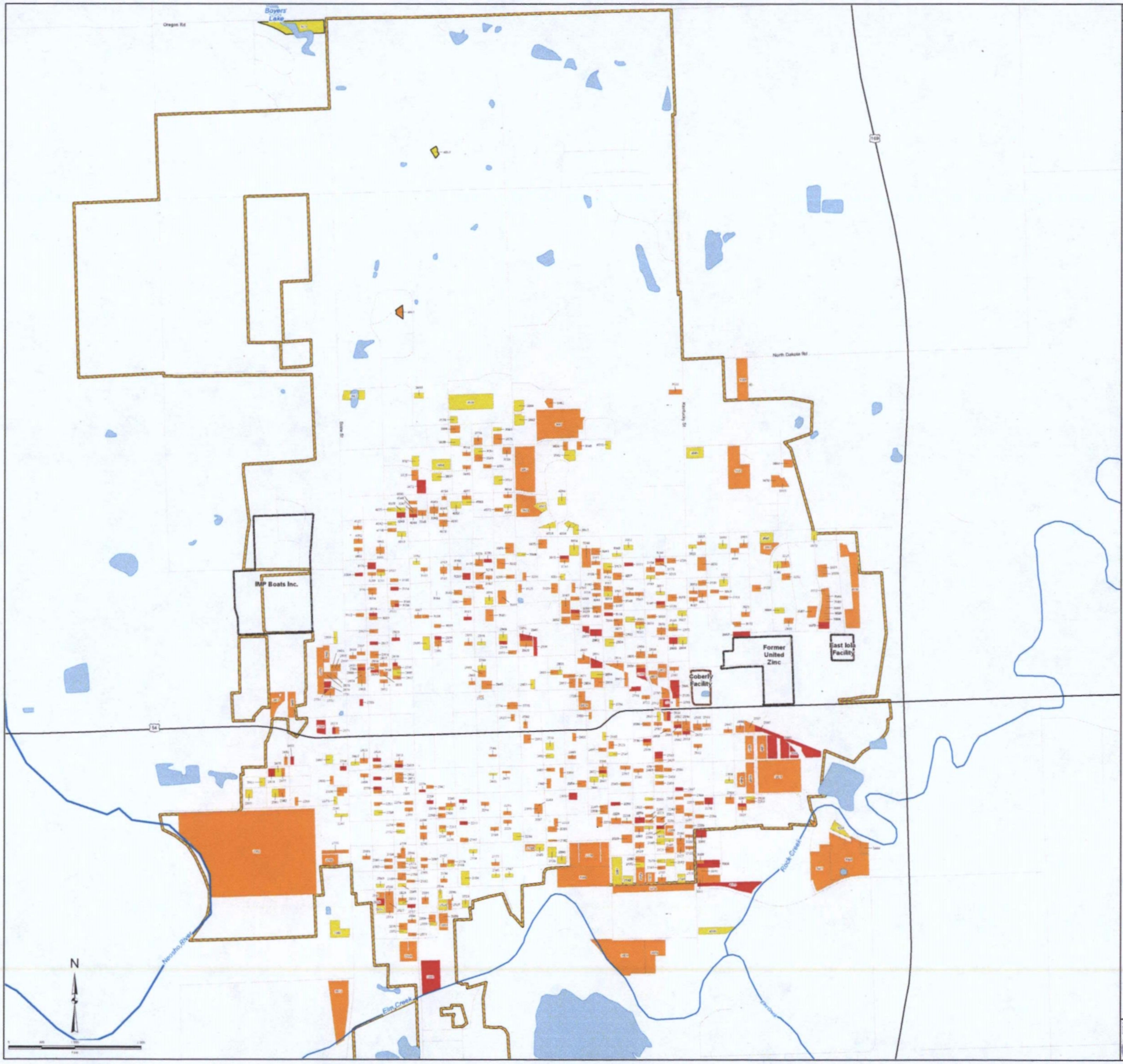
Note:
This plate does not include the Arsenic Reanalysis Study data from 2015 and 2016.

The highest concentration detected in the samples collected at a particular property was used to evaluate the remediation at that property on the plate map.

BKG=background concentration
EPA=U.S. Environmental Protection Agency
mg/kg=milligrams per kilogram
RSL=regional screening level

HGL

Plate 9
Zinc Detections in Confirmation Surface Soil Samples



Legend

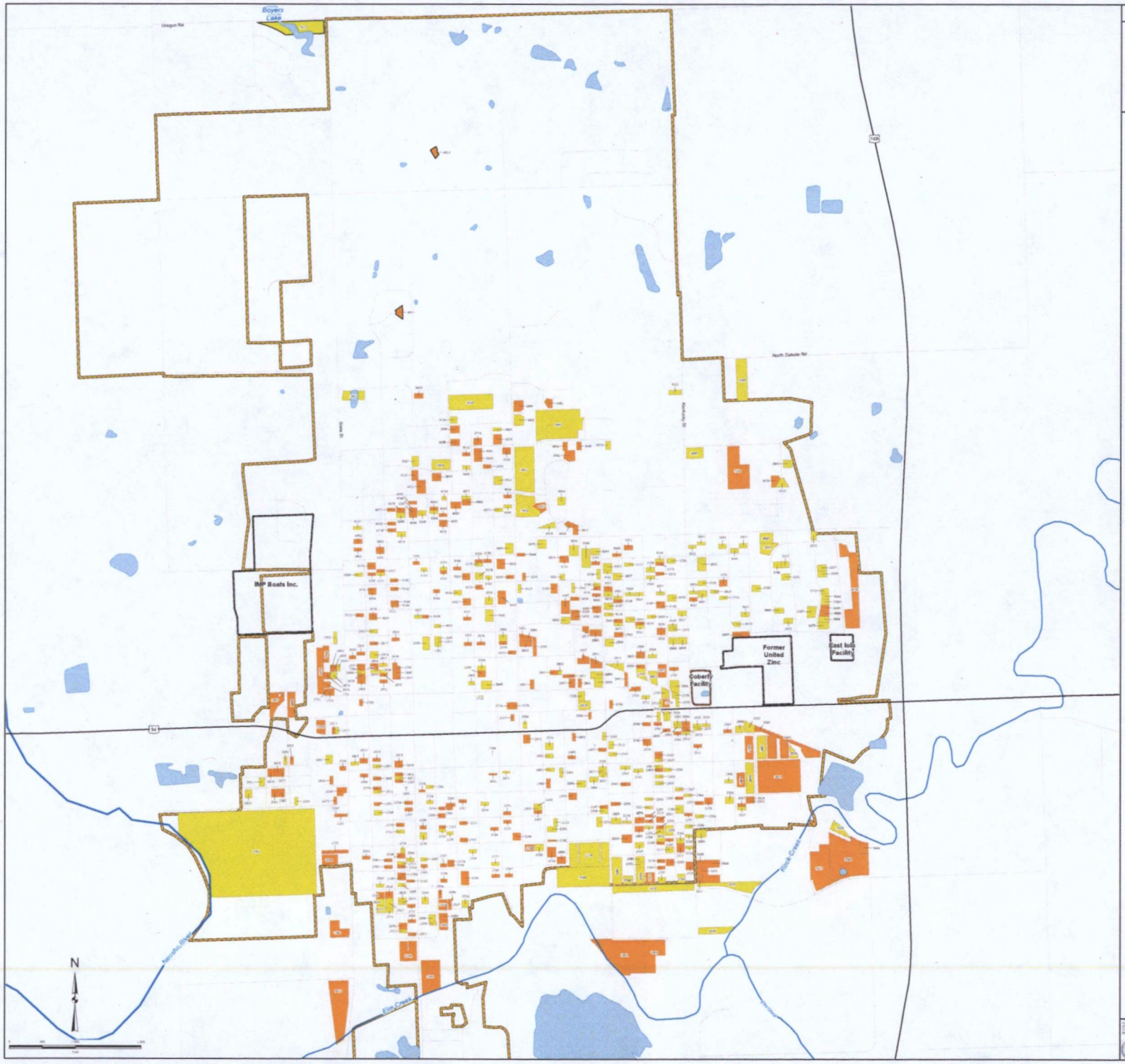
- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location
- Zinc Detected Below the BKG
- Zinc Detected Above the BKG
- Zinc Detected Above the EPA RSL for Residential Soil

Zinc in Soil (mg/kg)	
RSL	2,300
BKG	688

Notes:

This plate does not include the Arsenic Reanalysis Study data from 2015 and 2016.

Plate 10
Barium Detections in Confirmation Surface Soil Samples



Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location
- Barium Detected Below the BKG
- Barium Detected Above the BKG

Barium in Soil (mg/kg)	
RSL	1,500
BKG	280

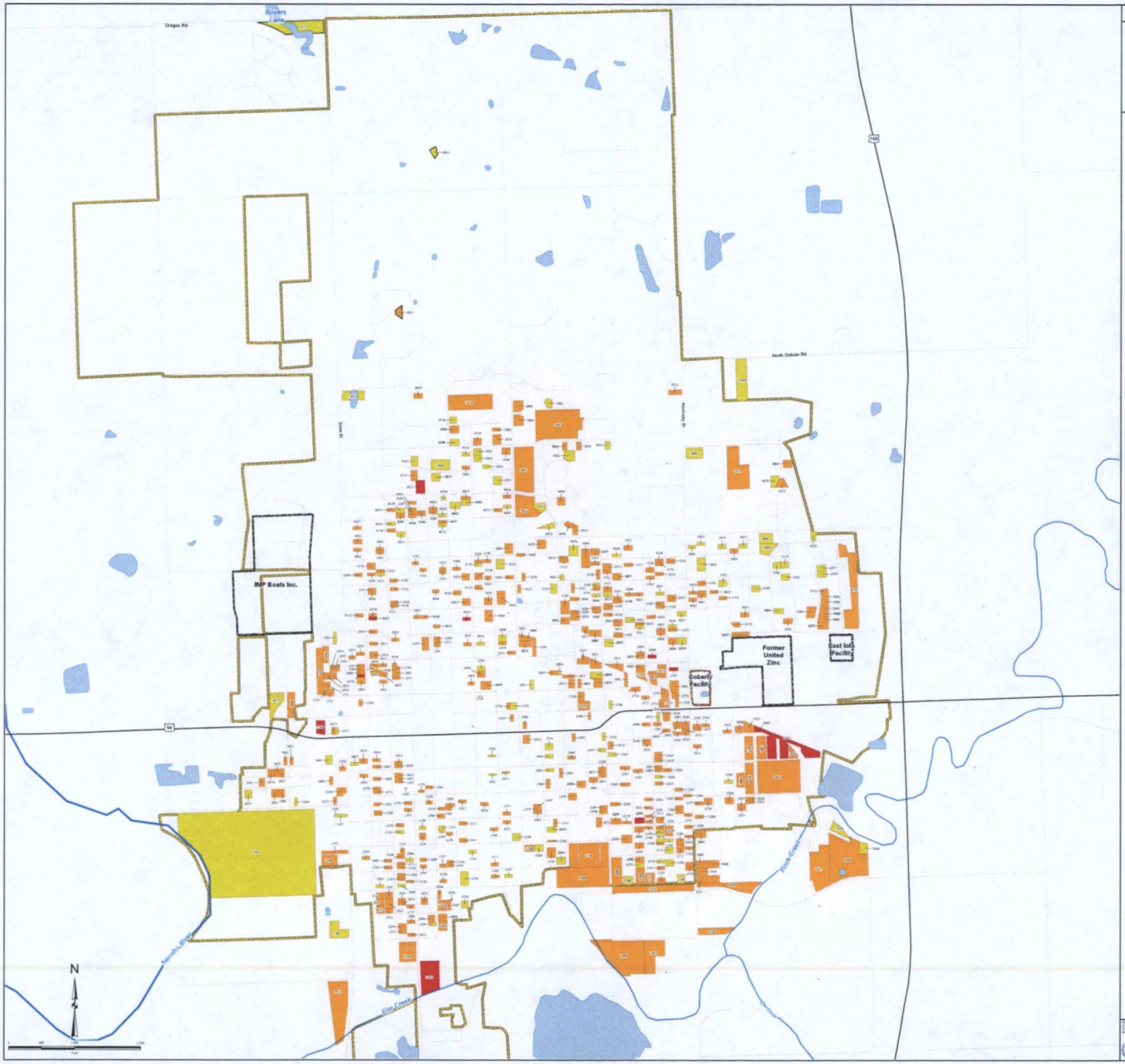
Note:
This plate does not include the Arsenic Reanalysis Study data from 2015 and 2016.

The highest concentration detected in the sample collected at a particular property was used to define the concentration of that property on the plate map.

BKG=background concentration
RSL=U.S. Environmental Protection Agency regional screening level
mg/kg=milligrams per kilogram
N/A=not applicable

HGL

Plate 11
Copper Detections in Confirmation Surface Soil Samples



Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location
- Copper Detected Below the BKG
- Copper Detected Above the BKG
- Copper Detected Above the EPA RSL for Residential Soil

Copper in Soil (mg/kg)	
RSL	310
BKG	32.4

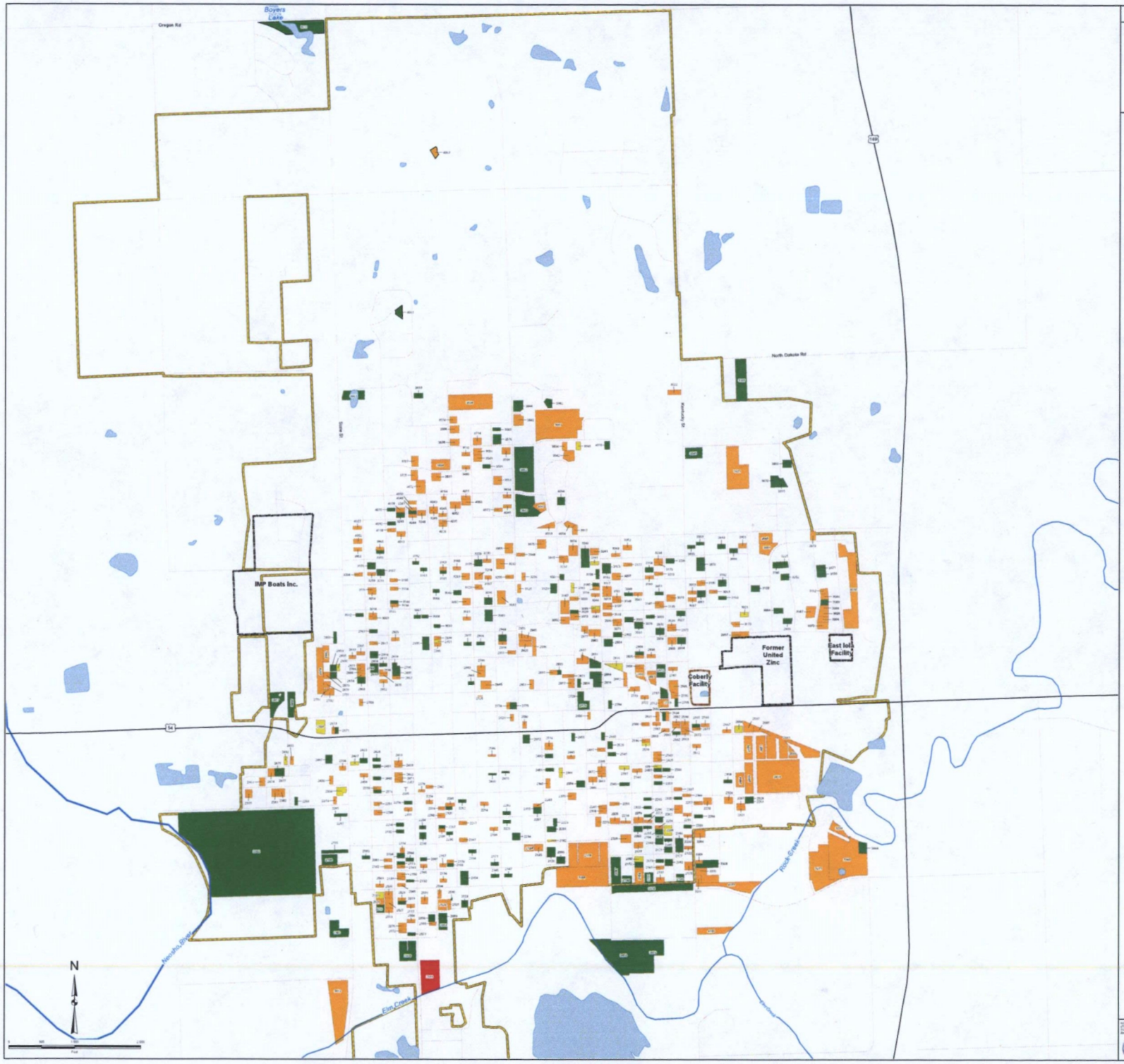
Note:
This plate does not include the Arsenic Reanalysis Study data from 2015 and 2016.

The highest concentration detected in the samples collected at a particular property was used to define the exceedance or BKG property on the plan map.

BKG=Background concentration
EPA=U.S. Environmental Protection Agency
mg/kg=milligrams per kilogram
RSL=regional screening level

HGL

Plate 12
Silver Detections in Confirmation Surface Soil Samples



Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location
- Nondetect at the Reporting Limit
- Silver Detected Below the BKG
- Silver Detected Above the BKG
- Silver Detected Above the EPA RSL for Residential Soil

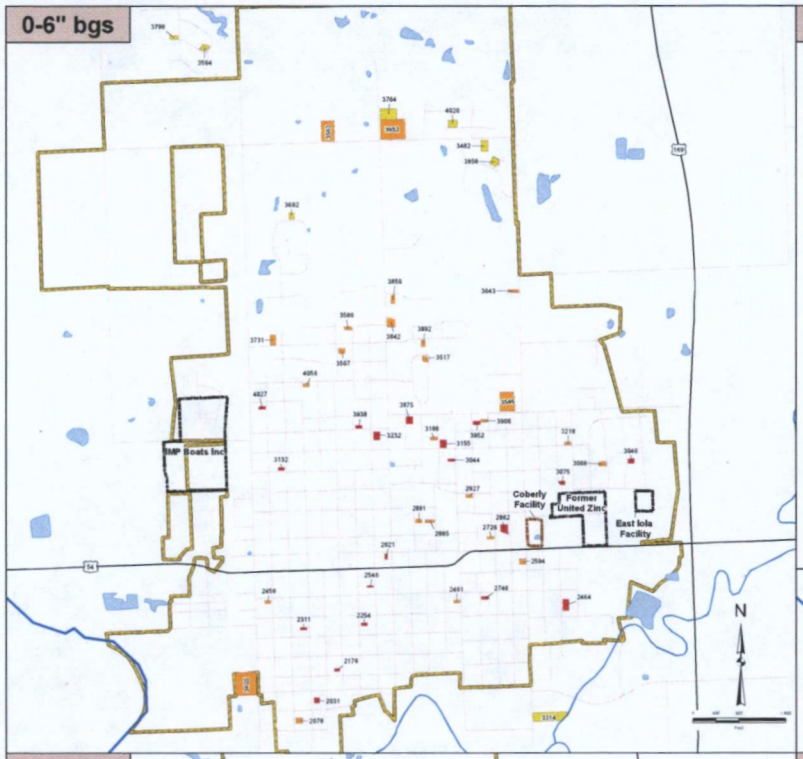
Silver in Soil (mg/kg)	
RSL	39
BKG	1.3

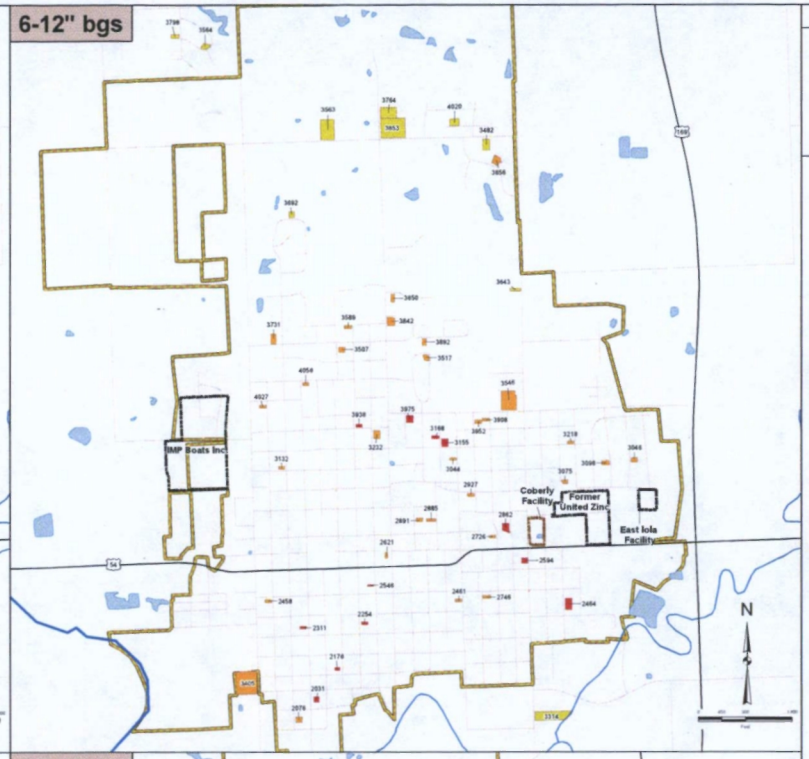
Note:
This plate does not include the Arsenic Reanalysis Study data from 2015 and 2016.

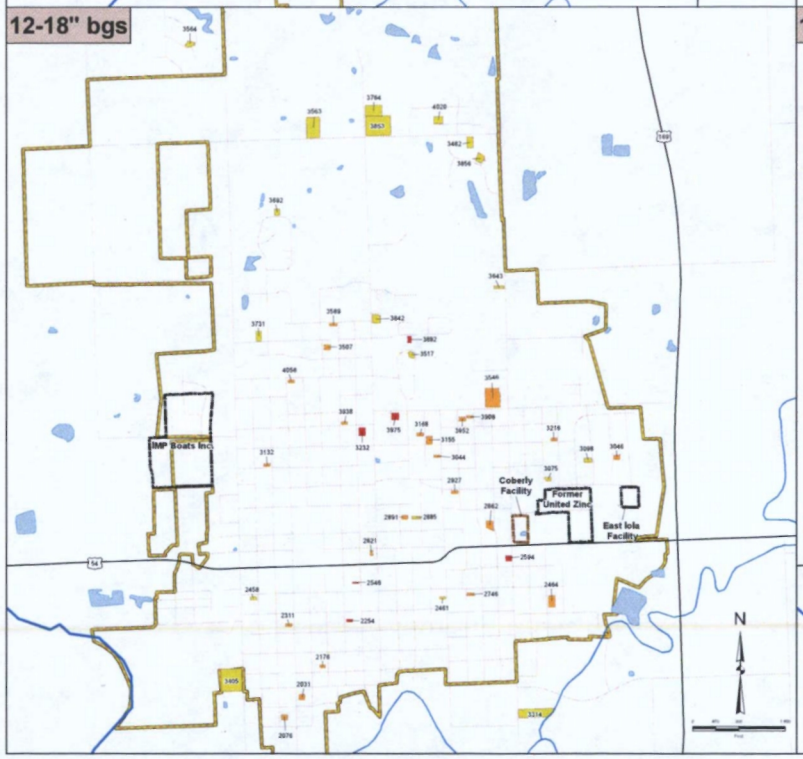
The highest concentration detected in the samples collected at a particular property was used to define the concentration at that property on the plot map.

BKG=background concentration
EPA=U.S. Environmental Protection Agency
mg/kg=milligrams per kilogram
RSL=regional screening level

HGL







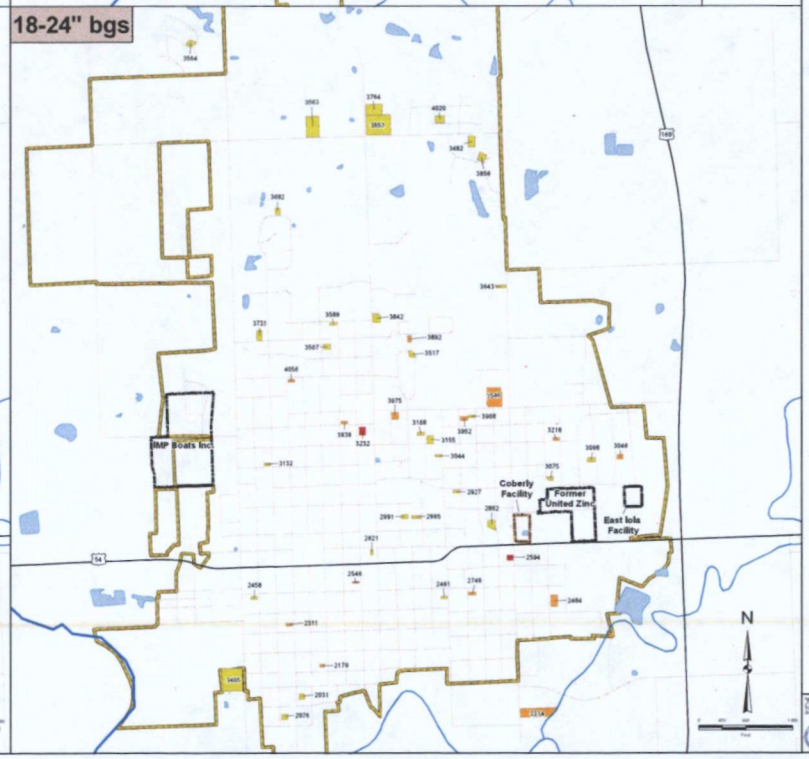


Plate 13
Lead Detections in
Screening Subsurface Soil Samples

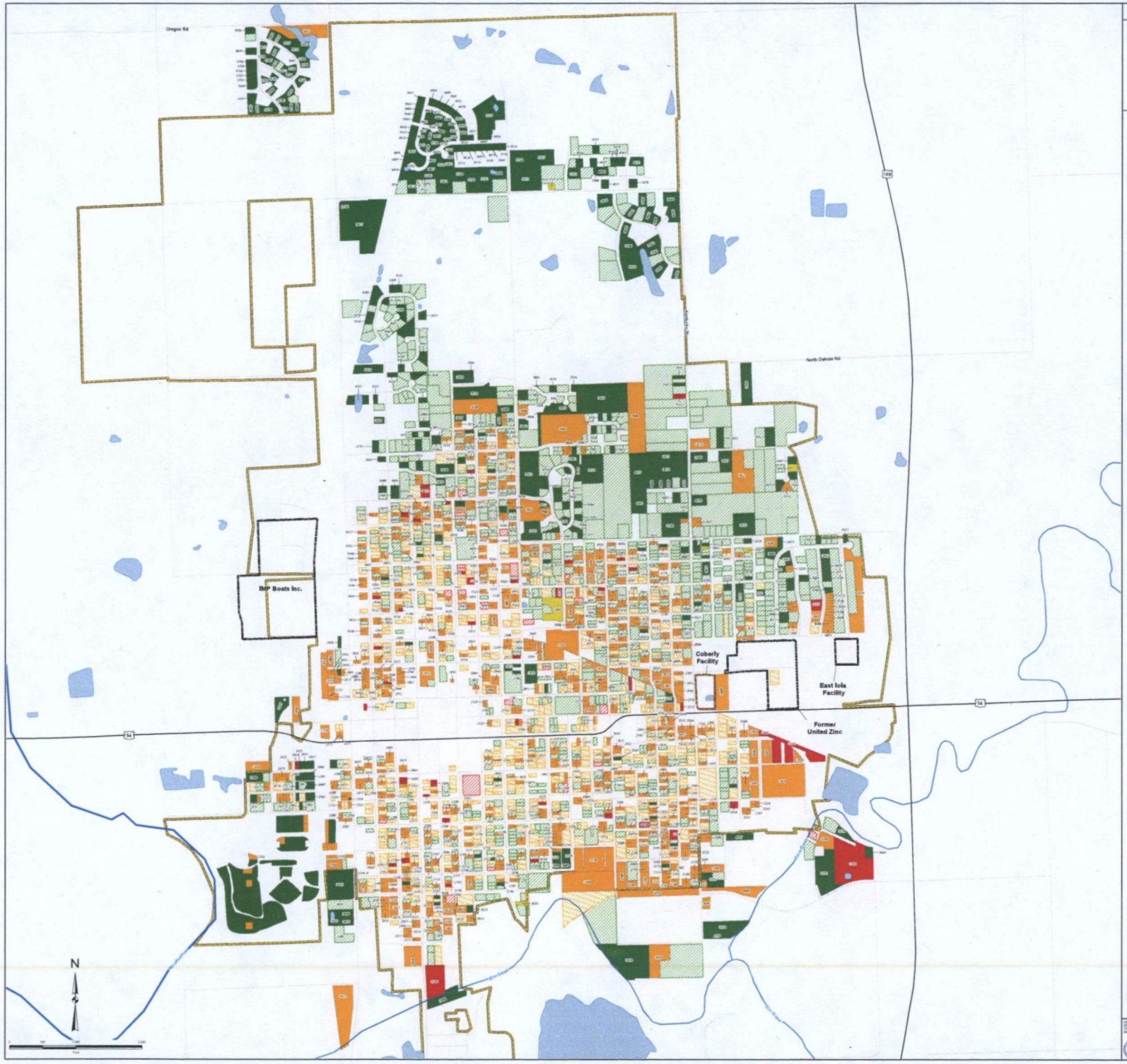
Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- Iola City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Lead Detected below the BKG
- Lead Detected above the BKG
- Lead Detected above the EPA RSL for Residential Soil

Lead in Soil (mg/kg)	
RSL	400
BKG	52.4

HGL

Plate 14
Combined Surface Soil Screening Results



Legend

- EPA Site ID
- Road
- Major Road
- Creek
- Neosho River
- Surface Water Body
- City Limits
- Suspected Waste Disposal Area
- Former Smelter
- Surface Soil Background Location

HGL Sampled Properties

- No Exceedances
- Lead Detected Above the Cleanup Goal
- Arsenic Detected Above the Cleanup Goal
- Lead and Arsenic Detected Above the Cleanup Goals

Tetra Tech Sampled Properties

- No Exceedances
- Lead Detected Above the Cleanup Goal
- Lead and Arsenic Detected Above the Cleanup Goal

HGL

APPENDIX II

TABLES

Table 4.4
Lead Screening Data - Surface and Subsurface Soil Range of Detections
Former United Zinc Site, Iola Kansas

Lead	Residential Soil RSL	Detection Range[2]		Number of Detections[1]	RSL Exceedances
		Minimum	Maximum		
Surface	400	9	66,445	7,398	2,070
0-6 inches		33	1,174	52	19
6-12 inches		18	2,949	51	12
12-18 inches		22	1,275	48	6
18-24 inches		21	557	47	3

Notes:

[1]The number of lead detections matches the number of samples analyzed for a particular interval.

[2]Results used are for RI field effort in 2013 and 2014.

The analytical results and RSLs are in milligrams per kilogram.

EPA = U.S. Environmental Protection Agency

RSL = EPA Regional Screening Level for Residential Soil (May 2014)

Table 4.5
Confirmation Surface Soil Sample Range of Detections
Former United Zinc Site, Iola, Kansas

TAL Metals	Residential Soil RSL[1]	Detection Range[2]		Number of Detections	Number of Detections Exceeding Residential Soil RSL
		Minimum	Maximum		
Aluminum	7,700	1,790	30,400 J	791	624
Antimony	3.1	3.5 J	19.9	11	11
Arsenic	0.67	5.0	221	766	766
Barium	1,500	29.8	1,220	791	0
Beryllium	16	0.44	3.3	571	0
Cadmium	7	0.57	88.9	775	190
Calcium	nsv	2,880	271,000	791	nsv
Chromium	0.30	5.5	91.5	791	791
Cobalt	2.3	3.7	21.8	715	715
Copper	310	9.3	6,530	791	11
Iron	5,500	7,800	114,000	791	791
Lead	400	26.6	14,500	764	439
Magnesium	nsv	838	8,680	791	nsv
Manganese	180	272	1,910	752	752
Molybdenum	39	0	0	0	0
Nickel	150	5.1	75.1	791	0
Potassium	nsv	538	4,660	789	nsv
Selenium	39	2.5	15.1	24	0
Silver	39	0.73	59.6	477	1
Sodium	nsv	47.2	619	87	nsv
Thallium	0.078	2.6 J	6.1	2	2
Vanadium	39	9.0 J	53.5	789	58
Zinc	2,300	68	55,300	791	87

Notes:

[1]All samples were analyzed by the EPA Region 7 laboratory for Target Analyte List metals.

[2]Results used are for RI field effort in 2013 and 2014.

There were 791 surface soil samples analyzed (including 78 duplicate samples).

The analytical results and RSLs are in milligrams per kilogram.

EPA = U.S. Environmental Protection Agency

J = The identification of the analyte is acceptable; the reported value is an estimate.

nsv = no screening value

RSL = EPA Regional Screening Level for Residential Soil (May 2014)

TAL = Target Analyte List

Table 4.8
Analytical Data Summary - ASR 6107
Former United Zinc Site, Iola, Kansas

Sample ID	Sample Location	Pb*	Al	Sb	As*	Ba*	Be	Cd*	Ca	Cr	Co	Cu	Fe*	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Tl	V	Zn*
6107-1	3096-C4	201	6,770	6.7 U	6.7	158	0.65 U	2.7	17,400	10.7	5.8 U	42.8	10,800	1,460	360	NA	9.4	1,520	3.9 U	1.1 U	561 U	2.8 UJ	24.5	610
6107-2	3197-C1	500	7,430	6.5 U	11.9	179	0.71 U	4.1	102,000	12.1	9.6	67.6	16,900	3,430	633	NA	16.8	1,690	3.8 U	1.6	544 U	2.7 UJ	23.6	1,320
6107-3	2788-C3	444	7,230	5.9 U	5.8	206	0.75 U	4.2	9,420	11.7	7.0 U	25.8	10,500	1,170	329	NA	10.6	1,230	3.4 U	0.98 U	488 U	2.4 UJ	23.8	1,250
6107-4	2950-E1	914	6,000	7.8 U	16.0	404	0.65 U	8.4	88,300	11.6	8.8	111	25,600	3,110	658	NA	19.9	1,210	4.6 U	2.4	652 U	3.3 UJ	26.0	3,190
6107-5	2220-E1	280	8,580	6.0 U	7.3	186	0.83 U	2.8	21,400	11.2	6.8 U	35.7	11,800	1,630	342	NA	11.9	1,180	3.5 U	1.0 U	500 U	2.5 UJ	28.1	1,370
6107-6	2590-E2	695	8,770	6.0 U	12.3	127	0.71 U	5.8	39,300	13.9	8.4	61.1	15,700	2,120	576	NA	14.6	1,360	3.5 U	1.8	503 U	2.5 UJ	27.2	1,610
6107-7	3033-C2	371	6,360	7.0 U	9.6	143	0.64 U	3.7	113,000	11.1	6.6 U	51.9	14,800	3,060	556	NA	14.5	1,650	4.1 U	1.2 U	583 U	2.9 UJ	20.4	1,220
6107-8	2920-C2	704	6,840	7.4 U	13.9	206	0.66 U	4.5	18,200	11.2	7.7 U	83.3	13,400	2,000	482	NA	12.4	1,770	4.3 U	2.6	617 U	3.1 UJ	24.3	1,540
6107-9	2918-C2	2,740	7,250	7.2 U	27.1	416	0.78 U	12.7	27,600	17.7	8.0 U	296	22,100	1,950	673	NA	21.4	1,730	4.2 U	7.5	600 U	3.0 UJ	28.2	4,830
6107-10	3114-E2	729	7,660	7.5 U	13.9	183	0.75 U	6.9	18,700	12.3	8.2 U	74.8	14,600	1,550	441	NA	12.9	1,390	4.4 U	4.3	624 U	3.1 UJ	29.1	2,470
6107-11	2597-C3	639	6,420	6.0 U	8.7	179	0.73 U	8.6	9,620	10.2	5.7 U	77.5	12,200	1,280	402	NA	12.2	1,570	3.5 U	1.9	497 U	2.5 UJ	20.4	2,210
6107-12	2938-E1	861	8,080	7.7 U	24.4	165	0.87 U	7.3	24,900	13.4	7.8 U	70.5	16,800	1,940	516	NA	16.3	1,630	4.5 U	2.2	644 U	3.2 UJ	29.7	2,340
6107-13	3097-SS-C1	252	9,200	6.9 U	7.5	282	0.86 U	3.6	15,000	13.5	7.6 U	43.9	16,200	1,810	506	NA	14.4	1,610	4.0 U	1.2 U	576 U	2.9 UJ	29.8	836
6107-13-FD	3097-SS-C1	264	9,020	7.0 U	7.5	170	0.83 U	3.6	15,400	13.3	7.7 U	43.4	16,600	1,740	532	NA	14.1	1,570	4.1 U	1.2 U	582 U	2.9 UJ	29.6	854
6107-15	3097-SS-C2	265	7,950	7.1 U	6.7	189	1.0 U	2.5	36,300	23.0	9.3	39.0	12,100	2,790	475	NA	15.3	1,560	4.1 U	1.2 U	588 U	2.9 UJ	22.7	749
6107-15-FD	3097-SS-C2	305	7,430	7.0 U	6.2	189	0.98 U	3.0	33,600	19.9	11.8	43.0	13,700	2,430	630	NA	15.9	1,480	4.1 U	1.6	587 U	2.9 UJ	23.4	959
6107-17	3190-SS-E1	606	9,670	6.1 U	10.1	178	0.94 U	3.3	27,500	14.2	9.9	62.0	18,600	1,910	576	NA	16.3	1,400	3.6 U	2.4	511 U	2.6 UJ	32.3	1,090
6107-18	3103-SS-C2	282	9,250	6.5 U	9.1	144	0.83 U	5.8	7,310	14.3	10.5	46.1	18,000	1,420	545	NA	13.3	1,020	3.8 U	1.1 U	541 U	2.7 UJ	33.3	1,070
6107-19	2660-SS-C1	238	6,290	6.3 U	6.3	131	0.52 U	1.6	18,000	11.0	5.8 U	27.5	11,500	1,420	356	NA	9.8	1,040	3.7 U	1.0 U	522 U	2.6 UJ	21.6	470
6107-19-FD	2660-SS-C1	243	6,800	6.4 U	6.5	134	0.53 U	1.6	16,500	11.8	5.3 U	28.5	11,200	1,440	337	NA	9.8	1,120	3.7 U	1.1 U	530 U	2.7 UJ	22.6	494
6107-21	2397-SS-C2	493	7,990	6.7 U	12.2	147	0.76 U	4.5	11,500	13.0	9.7	52.6	14,500	1,560	663	NA	13.1	929	3.9 U	1.2	559 U	2.8 UJ	28.4	1,210
6107-22	3021-SS-C3	375	7,630	6.8 U	11.0	152	0.75 U	7.9	32,000	15.1	8.6	75.1	16,200	2,650	600	NA	12.3	1,050	4.0 U	1.1	568 U	2.8 UJ	30.2	1,430
6107-23	2565-SS-C2	334	8,200	6.6 U	9.2	164	0.78 U	4.8	47,900	18.0	7.1 U	50.0	16,500	2,740	413	NA	16.6	1,590	3.9 U	1.1 U	552 U	2.8 UJ	23.7	1,150
6107-24	3122-SS-C3	303	7,250	6.0 U	7.8	120	0.74 U	6.6	5,990 J	12.1	9.8	30.9	14,700 J	999	507 J	NA	9.6	770	3.5 U	1.0 U	502 U	2.5 UJ	33.6	1,160
6107-25	2684-SS-C1	461	5,770	6.0 U	10.0	174	0.70 U	6.1	11,700	12.0	11.9	43.6	19,600	1,230	837	NA	16.5	1,160	3.5 U	1.0	496 U	2.5 UJ	25.7	1,590
6107-26	2677-SS-E1	441	3,690	6.1 U	8.4	104	0.50 U	6.8	169,000	10.9	5.0 U	55.1	15,200	5,670	621	NA	23.3	992	3.5 U	1.5	505 U	2.5 UJ	15.0	1,480
6107-27	3061-SS-C4	264	6,760	6.3 U	8.2	153	0.73 U	4.2	13,800	11.1	6.9 U	39.0	13,000	1,400	510	NA	10.8	1,390	3.7 U	1.1 U	526 U	2.6 UJ	29.3	878
6107-27-FD	3061-SS-C4	260	6,660	6.1 U	9.3	172	0.72 U	4.3	13,600	10.8	9.5	39.0	14,100	1,360	660	NA	11.3	1,350	3.6 U	1.0 U	512 U	2.6 UJ	28.2	846
6107-29	2948-SS-C4	159	5,400	6.7 U	5.0	101	0.56 U	2.4	115,000	8.8	5.6 U	26.3	11,500	3,760	414	NA	11.5	1,370	3.9 U	1.1 U	559 U	2.8 UJ	17.0	518
6107-30	2651-SS-E1	372	5,330	5.9 U	7.1	118	0.60 U	5.0	46,800	8.3	5.0 U	42.9	10,500	2,070	367	NA	10.3	1,040	3.5 U	1.3	496 U	2.5 UJ	18.4	1,240
6107-30-FD	2651-SS-E1	362	5,000	5.9 U	6.1	114	0.60 U	4.8	64,000	7.9	5.0 U	39.8	10,000	2,300	391	NA	9.9	976	3.5 U	1.2	496 U	2.5 UJ	18.6	1,190
6107-32	2651-SS-C2	283	3,840	6.1 U	5.8	104	0.51 U	4.1	88,800	7.4	5.1 U	31.4	10,900	3,090	391	NA	8.4	1,280	3.6 U	1.0 U	512 U	2.6 UJ	15.1	1,890
6107-33	2651-SS-C8	273	6,340	6.7 U	6.4	161	0.69 U	5.4	11,400	9.1	6.5 U	33.7	10,800	1,480	466	NA	10.2	1,060	3.9 U	1.1 U	557 U	2.8 UJ	24.4	1,010
6107-34	2712-SS-C2	1,050	5,170	6.0 U	13.9	149	0.50 U	7.7	74,000	15.3	5.2 U	108	14,400	2,970	570	NA	13.3	1,320	3.5 U	3.6	497 U	2.5 UJ	20.5	2,260
6107-35	2566-SS-C1	546	8,620	6.2 U	9.7	143	0.80 U	6.9	18,600	13.0	7.2 U	56.2	14,500	1,410	376	NA	12.3	1,330	3.6 U	1.7	515 U	2.6 UJ	27.3	1,670
6107-36	2934-SS-C2	184	6,820	5.8 U	10.5	138	0.67 U	2.7	8,770	12.7	9.6	27.9	13,000	1,240	590	NA	10.8	1,750	3.4 U	0.97 U	486 U	2.4 UJ	31.0	580
6107-36-FD	2934-SS-C2	191	6,760	5.8 U	11.2	170	0.71 U	3.0	8,920	12.3	16.1	24.6	14,400	1,280	867	NA	11.5	1,760	3.4 U	0.97 U	486 U	2.4 UJ	32.1	604
6107-38	3059-SS-C1	697	6,680	6.0 U	12.0	167	0.60 U	8.0	18,100	13.3	7.3 U	78.4	15,400	3,020	507	NA	15.1	1,280	3.5 U	4.0	504 U	2.5 UJ	24.3	1,760
6107-39	2893-SS-C2	356	7,080	6.0 U	6.7	179	0.69 U	2.3	14,100	10.8	6.9 U	31.4	11,400	1,510	507	NA	10.6	1,610	3.5 U	0.99 U	496 U	2.5 UJ	24.8	620
6107-40	3013-SS-C3	466	6,110	6.1 U	12.8	232	0.65 U	3.0	32,200	11.8	8.2 U	49.6	13,300	1,860	659	NA	11.7	1,530	3.5 U	1.4	505 U	2.5 UJ	25.7	1,050
6107-41	2694-SS-E2	1,130	7,220	7.0 U	18.0	150	0.74 U	8.4	43,700	13.9	6.9 U	131	16,500	2,650	661	NA	15.7	910	4.1 U	3.7	584 U	2.9 UJ	25.1	2,720
6107-42	2871-SS-E1	429	8,520	6.8 U	10.2	199	0.75 U	4.0	31,800	11.4	10.3	59.4	14,300	2,220	692	NA	13.5	809	3.9 U	1.4	563 U	2.8 UJ	29.9	1,210
6107-43	3225-SS-C4	297	7,760	5.9 U	8.4	156	0.85 U	6.6	7,100	11.5	13.0	31.8	15,700	1,200	679	NA	14.2	1,930	3.5 U	0.99 U	494 U	2.5 UJ	31.5	1,070

Table 4.8 (Continued)
Analytical Data Summary - ASR 6107
Former United Zinc Site, Iola, Kansas

Sample ID	Sample Location	Pb*	Al	Sb	As*	Ba*	Be	Cd*	Ca	Cr	Co	Cu	Fe	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Tl	V	Zn*
6107-44	2445-SS-C3	1,020	5,610	7.7 U	8.3	255	0.64 U	45.7	110,000	12.1	6.4 U	47.2	13,100	3,720	461	NA	10.5	1,000	4.5 U	1.3 U	642 U	3.2 UJ	18.4	6,390
6107-45	2395-SS-C3	530	6,910	5.9 U	12.2	135	0.76 U	7.1	6,630	11.2	6.5 U	53.8	13,000	1,100	432	NA	11.6	813	3.4 U	1.7	491 U	2.5 UJ	26.6	1,660
6107-46	2598-SS-C4	762	6,930	5.9 U	11.0	255	0.63 U	9.6	75,300	13.4	6.4 U	1370	15,900	3,070	393	NA	14.9	890	3.4 U	1.1	492 U	2.5 UJ	22.8	3,270
6107-47	3063-SS-C4	527	5,520	5.9 U	7.9	163	0.53 U	8.9	138,000	12.7	5.7 U	53.2	14,900	4,820	538	NA	13.6	1,430	3.4 U	2.2	491 U	2.5 UJ	18.3	1,260
6107-48	2775-SS-C2	406	8,800	6.8 U	7.8	236	0.86 U	2.6	11,300	16.6	10.8	28.3	16,600	1,740	846	NA	17.9	1,080	4.0 U	1.1 U	570 U	2.8 UJ	29.5	832
6107-49	3240-SS-C1	321	7,890	6.0 U	8.1	165	0.78 U	3.1	9,720	13.2	7.6 U	41.0	14,300	1,660	510	NA	14.9	2,380	3.5 U	0.99 U	497 U	2.5 UJ	25.6	894
6107-50	2977-SS-C2	836	8,370	6.6 U	13.7	257	0.78 U	7.2	42,100	15.7	10.1	103	19,400	2,570	650	NA	17.4	1,470	3.9 U	2.7	553 U	2.8 UJ	27.2	3,050
6107-51	3027-SS-C4	114	8,570	6.3 U	5.1	145	0.79 U	1.4	11,200	12.2	7.7 U	22.3	14,600	1,730	517	NA	14.9	1,400	3.7 U	1.1 U	526 U	2.6 UJ	24.7	323
6107-52	2481-SS-C3	372	8,030 J	6.2 U	8.0 J	132 J	0.69 U	3.4	12,900 J	12.5	11.1	32.1	13,200 J	1,310	625 J	NA	12.4	1,030	3.6 U	1.0 U	513 U	2.6 UJ	28.8 J	830
6107-53	2884-SS-C1	208	5,640	5.9 U	5.1	169	0.50 U	2.2	44,600	12.4	5.0 U	29.2	11,600	2,820	392	NA	10.5	1,300	3.5 U	0.99 U	495 U	2.5 UJ	19.3	609
6107-54	3086-SS-C1	403	7,350	6.0 U	7.7	205	0.68 U	2.7	24,300	12.3	6.3 U	34.8	12,700	1,850	464	NA	12.2	1,450	3.5 U	1.0 U	500 U	2.5 UJ	24.6	882
6107-55	3086-SS-E1	320	10,200	6.0 U	8.6	181	0.91 U	2.3	21,900	12.5	8.2 U	38.4	15,900	1,960	474	NA	13.0	1,090	3.5 U	1.0	503 U	2.5 UJ	33.3	747
6107-56	2924-SS-C1	171	8,570	5.9 U	7.4	156	0.91 U	2.2	24,600	12.5	8.1 U	17.9	18,300	2,330	592	NA	16.5	961	3.4 U	0.98 U	492 U	2.5 UJ	30.2	450
6107-57	3207-SS-C1	527	8,500	6.1 U	8.6	169	0.78 U	4.1	40,600	14.1	8.4	50.9	15,200	2,520	548	NA	14.8	1,280	3.5 U	1.3	505 U	2.5 UJ	27.0	1,210
6107-58	2963-SS-C2	729	8,420	6.0 U	11.7	196	0.77 U	9.2	10,700	11.2	9.2	92.3	17,800	1,590	605	NA	14.0	1,100	3.5 U	2.9	500 U	2.5 UJ	29.3	3,350
6107-59	3018-SS-E1	1,610	6,610	6.0 U	21.2	153	0.60 U	13.7	44,800	10.6	7.5 U	154	21,000	2,490	672	NA	13.2	1,050	3.5 U	8.0	498 U	2.5 UJ	26.4	3,880
6107-60	2887-SS-C3	470	5,060	6.0 U	7.1	169	0.64 U	4.1	65,900	8.8	5.0 U	50.0	12,600	2,770	504	NA	11.2	1,570	3.5 U	1.5	497 U	2.5 UJ	21.4	1,270
6107-61	2900-SS-C3	159	7,290	6.3 U	5.7	140	0.68 U	1.9	28,400	9.8	6.2 U	24.5	13,000	1,790	426	NA	10.5	1,440	3.7 U	1.1 U	529 U	2.6 UJ	24.6	542
6107-62	2900-SS-E1	954	5,930	7.7 U	13.7	136	0.64 U	7.6	95,400	10.5	6.4 U	118	17,100	4,060	735	NA	16.5	958	4.5 U	3.6	639 U	3.2 UJ	22.3	2,360
6107-63	3117-SS-C3	979	8,900	7.3 U	21.8	222	0.84 U	4.0	10,600	12.9	13.4	46.2	17,800	1,760	920	NA	14.1	1,190	4.3 U	2.1	610 U	3.0 UJ	33.5	1,310
6107-64	3117-SS-G	160	7,810	7.7 U	10.2	190	0.65 U	2.6	17,700	11.9	7.1 U	35.0	13,600	2,170	435	NA	12.0	1,470	4.5 U	1.3 U	644 U	3.2 UJ	27.3	656
6107-64-FD	3117-SS-G	183	7,700	7.8 U	11.4	179	0.66 U	1.9	18,600	11.8	6.6 U	45.5	14,100	2,060	396	NA	12.0	1,460	4.5 U	1.3 U	648 U	3.2 UJ	27.1	693
6107-66	3137-SS-C1	809	6,560	5.9 U	14.5	174	0.73 U	7.1	16,200	10.3	10.1	75.0	16,500	1,690	651	NA	11.6	1,330	3.4 U	2.8	493 U	2.5 UJ	30.1	2,040
6107-67	3137-SS-E2	595	4,720	5.9 U	9.5	128	0.50 U	6.0	191,000	7.6	5.8 U	53.0	14,300	4,060	611	NA	11.0	724	3.4 U	2.4	491 U	2.5 UJ	20.5	1,720
6107-68	3185-SS-C3	290	6,440 J	6.1 U	13.2 J	173 J	0.73 U	3.0	64,800 J	12.3	7.9 U	30.9 J	14,600 J	2,660 J	591 J	NA	12.5	1,160	3.5 U	1.0 U	505 U	2.5 UJ	23.4 J	804 J
6107-69	2831-SS-C1	270	7,430	6.0 U	7.2	223	0.70 U	2.5	17,500	14.2	6.9 U	38.1	12,100	1,240	419	NA	12.0	1,230	3.5 U	1.0 U	502 U	2.5 UJ	25.7	703
6107-70	2831-SS-C4	710	4,110	6.0 U	10.3	109	0.50 U	9.3	23,700	8.8	5.0 U	54.9	14,500	1,300	346	NA	10.8	709	3.5 U	1.0 U	498 U	2.5 UJ	15.6	2,350
6107-71	2715-SS-C2	487	3,840	6.6 U	6.3	97.5	0.55 U	4.5	150,000	14.2	5.5 U	42.8	13,900	4,620	492	NA	12.1	552 U	3.9 U	1.1 U	552 U	2.8 UJ	14.1 U	1,200
6107-71-FD	2715-SS-C2	530	3,840	6.7 U	6.3	108	0.56 U	3.8	162,000	15.6	5.6 U	40.0	14,600	4,600	500	NA	12.6	577	3.9 U	1.1 U	556 U	2.8 UJ	13.8 U	1,040
6107-73	3181-SS-C4	587	9,030	6.8 U	10.8	214	0.95 U	3.5	18,400	15.2	9.9	52.9	17,700	1,510	671	NA	15.5	1,350	4.0 U	1.1	568 U	2.8 UJ	29.0	997
6107-74	3202-SS-C4	272	6,810	6.0 U	6.8	147	0.86 U	6.6	4,850	10.0	7.4 U	26.5	13,300	883	473	NA	10.7	1,550	3.5 U	0.99 U	496 U	2.5 UJ	26.9	1,010
6107-75	2692-SS-E1	388	6,660	6.0 U	8.5	120	0.59 U	5.0	83,900	13.7	5.7 U	34.0	16,300	2,870	422	NA	24.6	1,120	3.5 U	1.0 U	502 U	2.5 UJ	21.0	1,130
6107-76	2360-SS-C1	360	8,660	6.0 U	7.0	167	0.79 U	5.8	10,300	12.5	9.8	35.9	13,400	1,180	468	NA	12.7	1,170	3.5 U	1.0 U	504 U	2.5 UJ	27.5	868
6107-77	2838-SS-C1	176	7,990	5.9 U	6.5	165	0.81 U	1.7	24,900	10.5	9.2	20.5	13,100	1,440	590	NA	10.5	848	3.4 U	0.98 U	490 U	2.5 UJ	32.3	433
6107-78	2838-SS-E1	844	6,700	5.9 U	12.0	135	0.63 U	5.7	22,200	10.7	7.8 U	354	16,400	1,420	699	NA	11.4	747	3.5 U	3.0	495 U	2.5 UJ	28.4	1,990
6107-79	3619-SS-C4	183	9,810	5.9 U	8.6	185	1.1 U	2.5	6,830	17.6	12.6	43.6	23,800	1,200	837	NA	21.1	1,710	3.5 U	0.99 U	493 U	2.5 UJ	39.0	476
6107-80	3076-SS-C3	399	8,940	6.2 U	8.8	262	1.1 U	3.4	13,700	13.1	7.0 U	44.2	17,200	1,240	409	NA	14.9	1,420	3.6 U	1.0 U	516 U	2.6 UJ	30.3	1,100
6107-81	3049-SS-C1	181	9,280	6.6 U	7.5	153	0.82	1.9	10,100	12.8	8.0	25.0	14,100	1,420	425	NA	12.0	1,320	3.8 U	1.1 U	546 U	2.7 UJ	28.0	488
6107-82	3049-SS-E1	515	7,000	6.0 U	10.3	132	0.64	4.3	40,700	11.2	7.4 U	60.8	14,300	2,010	513	NA	10.7	681	3.5 U	2.2	500 U	2.5 UJ	27.3	1,970
6107-83	3031-SS-C2	156	6,320	5.9 U	7.8	130	0.73	2.0	6,620	11.2	7.4 U	17.4	13,800	995	408	NA	9.4	936	3.5 U	0.99 U	495 U	2.5 UJ	32.2	485
6107-84	2808-SS-C4	1,120	7,030	5.9 U	11.8	329	0.76	11.3	18,000	15.2	10.7	41.0	15,800	1,290	1,130	NA	16.9	832	3.5 U	1.6	495 U	2.5 UJ	31.6	1,900
6107-85	3667-SS-C2	128	10,600	5.9 U	6.8	158	0.92	2.8	6,300	15.0	9.3	17.9	15,000	1,220	415	NA	13.6	1,150	3.5 U	0.99 U	495 U	2.5 UJ	31.6	507
6107-86	2360-SS-E1	678	8,670	6.0 U	11.2	224	0.71	6.1	22,000	13.1	7.5 U	76.5	14,500	1,590	542	NA	13.4	1,330	3.5 U	1.6	503 U	2.5 UJ	24.9	2,070

Table 4.8 (Continued)
Analytical Data Summary - ASR 6107
Former United Zinc Site, Iola, Kansas

Sample ID	Sample Location	Pb*	Al	Sb	As*	Ba*	Be	Cd*	Ca	Cr	Co	Cu	Fe	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Tl	V	Zn*
6107-87	3125-SS-E1	443	9,190	6.0 U	13.4	145	0.76	2.9	32,500	13.6	9.5	46.5	16,200	1,920	503	NA	13.1	1,140	3.5 U	1.5	500 U	2.5 UJ	28.3	1,040
6107-87-FD	3125-SS-E1	675	7,870	6.0 U	13.3	133	0.65	2.8	36,800	13.0	7.9	45.3	17,000	2,110	441	NA	12.8	1,030	3.5 U	2.3	498 U	2.5 UJ	25.9	975
6107-89	3183-SS-C2	337	6,500	5.9 U	9.9	158	0.69	3.3	25,000	18.1	7.1 U	39.6	14,300	1,960	482	NA	14.5	1,100	3.4 U	0.98 U	491 U	2.5 UJ	27.0	870
6107-89-FD	3183-SS-C2	354	7,500	6.0 U	10.2	165	0.71	3.5	25,000	14.3	8.1	39.3	14,800	1,550	538	NA	12.9	1,180	3.5 U	1.1	501 U	2.5 UJ	27.3	895
6107-91	2518-SS-C1	527	10,200	6.2 U	8.9	286	0.84	3.2	33,300	15.5	10.1	44.0	16,400	1,780	493	NA	15.3	1,680	3.6 U	1.1	516 U	2.6 UJ	32.2	1,130
6107-91-FD	2518-SS-C1	594	8,620	6.4 U	8.6	272	0.80	3.3	25,900	14.7	7.5 U	44.4	15,700	1,700	441	NA	13.8	1,570	3.7 U	1.1 U	531 U	2.7 UJ	28.2	1,130
6107-93	2662-SS-C4	150	5,660	6.0 U	9.0	192	0.59	2.3	47,900	12.8	10.3	29.9	14,100	2,200	990	NA	12.1	1,540	3.5 U	1.0 U	498 U	2.5 UJ	24.9	534
6107-94	2472-SS-E1	855	8,940	6.1 U	15.1	158	0.74	6.8	21,600	12.7	8.7	96.8	17,600	1,440	657	NA	13.2	1,030	3.5 U	3.6	505 U	2.5 UJ	30.8	2,320
6107-95	2472-SS-C1	271	7,560	6.2 U	7.3	177	0.71	2.3	34,500	12.2	5.9 U	36.5	12,400	1,530	401	NA	11.5	1,490	3.6 U	1.0 U	513 U	2.6 UJ	24.6	730
6107-96	2846-SS-C3	958	7,110	6.9 U	14.7	135	0.70	7.6	43,800	12.5	8.2	105	26,600	2,000	732	NA	20.4	1,140	4.0 U	2.9	573 U	2.9 UJ	25.8	2,980
6107-97	2586-SS-E1	620	9,290	6.3 U	25.7	190	0.83	6.3	27,400	14.1	7.3 U	67.3	17,200	1,900	556	NA	13.5	1,020	3.7 U	2.0	528 U	2.6 UJ	32.3	1,870
6107-98	2958-SS-C1	377	7,840	7.0 U	9.1	234	0.78	4.9	17,900	15.8	9.0	44.8	18,600	1,630	538	NA	13.7	1,470	4.1 U	1.2 U	586 U	2.9 UJ	28.1	1,340
6107-99	2668-SS-C3	797	7,130	6.1 U	11.7	407	0.74	7.0	21,200	15.3	7.5 U	63.4	15,000	1,620	477	NA	15.7	2,050	3.5 U	1.4	505 U	2.5 UJ	21.6	2,070
6107-100	2483-SS-C1	576	18,310 J	6.7 U	10.0	252 J	0.72	5.1	10,900 J	14.7	10.0	42.6 J	17,000 J	1,490	770 J	NA	14.5	1,250	3.9 U	1.1 U	555 U	2.8 UJ	27.7 J	1,430
Residential Soil RSL		400	7,700	3.1	0.67	1,500	16	7	nsv	0.3	2.3	310	5,500	nsv	180	39	150	nsv	39	39	nsv	0.078	39	2,300

Notes:

All samples were analyzed by the EPA Region 7 laboratory for Target Analyte List metals.

The analytical results and RSLs are in milligrams per kilogram.

* = Indicates a site related metal typically associated with lead and zinc mining and smelting activities.

Bold = analyte detected

Shaded analyte concentrations exceed EPA RSL for Residential Soil (May 2014).

RSL for noncancer metals have been adjusted down by a factor of 10

Element Symbols: Ag - Silver, Al - Aluminum, As - Arsenic, Ba - Barium, Be - Beryllium, Ca - Calcium, Cd - Cadmium, Co - Cobalt, Cr - Chromium, Cu - Copper, Fe - Iron, K - Potassium, Mg - Magnesium, Mn - Manganese, Mo - Molybdenum, Na - Sodium, Ni - Nickel, Pb - Lead, Sb - Antimony, Se - Selenium, Tl - Thallium, V - Vanadium, Zn - Zinc.

EPA = U.S. Environmental Protection Agency

ID = identification

J = The identification of the analyte is acceptable; the reported value is an estimate.

NA = not analyzed

nsv = no screening value

RSL = regional screening level

U = The analyte was not detected at or above the associated reporting limit.

UJ = The analyte was not detected at or above the associated reporting limit; the reported value is an estimate

Table 4.13
Analytical Data Summary - ASR 6224
Former United Zinc Site, Iola, Kansas

Sample ID	Sample Location	Pb*	Al	Sb	As*	Ba*	Be	Cd*	Ca	Cr	Co	Cu	Fe	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Tl	V	Zn*
6224-1	699-SS-C1	505	18,000	6.0 U	9.3	176	0.68	5.6	8,720	21.1	10.3 J	56.4	20,200	2,280	749	NA	13.1	2,110	3.5 U	1.1 J	503 U	2.5 U	43.0	1,220
6224-2	2017-SS-E1	1,190	17,400	6.1 U	19.4	197	0.57	11.6	65,200 J	22.4	11.0 J	113	23,000	3,580	719	NA	19.7	1,930	3.6 U	4.4	512 U	2.6 U	39.9	3,420
6224-2-FD	2017-SS-E1	1,280	16,900	6.1 U	20.6	189	0.57	12.0	71,300	20.8	8.6 J	116	23,200	3,620	659	NA	18.8	1,900	3.6 U	4.3	510 U	2.6 U	37.2	3,850
6224-4	2030-SS-C1	221	26,300	6.2 U	6.8 J	245	1.0	3.9	20,800	28.0	14.4 J	39.0	25,400	3,360	933	NA	24.0	3,920	3.6 U	1.0 UJ	517 U	2.6 U	40.4	739
6224-5	2068-SS-C6	302	22,400	6.0 U	7.6 J	264	0.87	4.5	15,000	23.8	11.3 J	50.0	23,400	2,870	535	NA	18.1	2,850	3.5 U	1.0 UJ	503 U	2.5 U	38.7	800
6224-6	2150-SS-C3	607	22,800	6.0 UJ	9.8	210	0.84	5.0	12,400	24.6	11.7 J	70.9	22,900	2,810	675	NA	16.2	2,740	3.5 U	2.0 J	504 U	2.5 U	42.4	1,540
6224-7	2150-SS-E1	307	30,400	6.0 U	8.1 J	416	1.0	3.4	10,800	27.2	13.6 J	48.7	24,000	4,110	661	NA	19.9	2,810	3.5 U	1.0 UJ	503 U	2.5 U	50.3	783
6224-8	2151-SS-G	459	17,200	6.0 U	8.3 J	255	0.79	4.8	14,100	21.2	7.9 J	71.5	21,000	2,110	584	NA	17.2	2,590	3.5 U	1.0 UJ	503 U	2.5 U	35.9	1,080
6224-9	2161-SS-C2	520	18,600	6.0 U	8.2 J	185	0.70	4.0	34,400	20.8	8.5 J	55.2	20,500	2,610	621	NA	15.1	2,970	3.5 U	1.7 J	503 U	2.5 U	36.1	1,090
6224-10	2163-SS-C1	679	21,100	6.1 U	11.4	220	0.75	5.4	12,900	22.7	12.9 J	64.8	21,000	2,700	831	NA	16.5	2,510	3.5 U	1.3 J	505 U	2.5 U	45.2	1,190
6224-11	2163-SS-C2	319	18,900	6.1 U	7.9 J	189	0.77	3.2	77,600 J	20.6	9.6 J	40.3	19,100	4,020	640	NA	16.5	2,540	3.6 U	1.0 UJ	508 U	2.5 U	38.1	622
6224-12	2182-SS-C1	303	22,800	6.0 U	16.8	246	1.0	4.3	48,500	25.5	18.4 J	50.3	29,100	3,790	1,440	NA	27.9	4,100	3.5 U	1.0 UJ	503 U	2.5 U	42.2	780
6224-12-FD	2182-SS-C1	299	22,900	6.0 U	11.3	263	0.99	4.7	42,400	24.3	18.3 J	49.1	28,500	3,660	1,540	NA	31.6	3,980	3.5 U	1.0 UJ	504 U	2.5 U	41.9	801
6224-14	2182-SS-E1	465	24,400	6.0 U	12.0	168	0.93	5.5	50,200	24.7	17.3 J	77.7	25,600	3,540	1,000	NA	23.6	2,990	3.5 U	1.1 J	503 U	2.5 U	40.3	1,270
6224-15	2203-SS-C2	270	20,400	6.1 U	6.1 J	241	0.84	4.7	11,700	25.1	11.7 J	64.7	25,700	2,470	775	NA	21.1	3,230	3.5 U	1.0 UJ	506 U	2.5 U	34.9	849
6224-16	2229-SS-C3	850	17,800	6.2 U	9.5	215	0.75	6.6	30,700	21.0	8.4 J	76.8	21,900	2,550	563	NA	17.6	3,050	3.6 U	3.0	517 U	2.6 U	34.8	1,670
6224-17	2270-SS-C1	780	17,900	6.1 U	15.1	190	0.67	7.9	49,400	22.4	8.8 J	87.2	21,300	3,310	746	NA	15.9	2,760	3.6 U	1.8 J	510 U	2.5 U	35.1	1,960
6224-18	2270-SS-C2	211	21,000	6.1 U	10.9	185	0.68	4.0	10,700	21.0	8.6 J	33.7	18,800	2,350	599	NA	15.1	3,150	3.6 U	1.0 UJ	508 U	2.5 U	36.2	627
6224-19	2270-SS-C3	1,860	15,700	6.1 U	21.9	256	0.60	15.8	22,900	20.9	9.1 J	164	27,600	2,500	888	NA	18.8	2,290	3.6 U	6.2	512 U	2.6 U	32.6	4,000
6224-20	2270-SS-C4	643	20,200	6.1 U	11.0	308	0.68	7.4	9,330	21.5	14.3 J	66.7	21,400	2,230	1,290	NA	15.5	2,780	3.6 U	2.1 J	510 U	2.5 U	40.4	1,480
6224-21	2270-SS-E1	2,000	14,500	6.2 U	21.2	136	0.52 U	12.6	17,900	16.2	7.3	189	25,400	2,580	795 U	NA	13.8	1,930	3.6 U	15.0	518 U	2.6 U	31.8	2,780
6224-22	2335-SS-C1	617	17,200	6.1 U	7.1	191	0.61	4.8	27,600	20.1	7.2	57.9	17,300	2,440	472 U	NA	15.2	2,630	3.6 U	1.0 UJ	512 U	2.6 U	29.7	994
6224-23	2520-SS-E1	331	18,600	6.0 U	11.5	145	0.58	5.5	44,700	24.1	8.5	36.1	17,900	3,230	478 U	NA	13.2	2,300	3.5 U	1.0 UJ	504 U	2.5 U	32.9	962
6224-23-FD	2520-SS-E1	417	18,000	6.0 U	11.5	148	0.60	6.4	46,400	28.1	13.0	36.6	18,400	4,250	752 U	NA	17.7	2,210	3.5 U	1.0 UJ	503 U	2.5 U	32.6	961
6224-25	2667-SS-C1	772	13,700	6.0 U	9.9	239	0.64	12.5	15,100	16.4	8.7	89.8	20,700	2,150	859 U	NA	13.8	3,230	3.5 U	2.6	503 U	2.5 U	27.7	2,150
6224-26	2667-SS-LS	1,150	15,100	6.0 U	9.0	218	0.67	9.9	13,700	26.4	9.4	81.4	25,000	2,010	654 U	NA	18.7	2,200	3.5 U	1.4 J	502 U	2.5 U	33.8	1,750
6224-27	2685-SS-C2	1,560	19,500	6.0 U	41.9	223	0.90	17.4	18,200	20.7	10.6	177	25,200	2,330	787 U	NA	19.2	1,850	3.5 U	6.1	502 U	2.5 U	38.4	5,330
6224-27-FD	2685-SS-C2	1,250	18,900	6.0 U	19.0	202	0.85	15.1	18,200	19.8	10.4	145	25,900	2,310	685 U	NA	20.1	1,790	3.5 U	3.8	503 U	2.5 U	38.6	4,480
6224-29	2685-SS-C3	4,960	12,000	6.0 U	27.9	613	0.62	36.5	6,070	34.9	10.8	508	36,500	1,250	576 U	NA	30.3	1,060	3.5 U	5.5	502 U	2.5 U	26.0	17,900
6224-30	2812-SS-C3	344	7,200	6.1 U	7.7	106	0.51 U	7.6	193,000	11.6	5.4	42.2	17,200	4,630	519 U	NA	13.1	1,510	3.6 U	1.0 UJ	512 U	2.6 U	18.5	842
6224-31	2812-SS-C4	242	13,200	6.2 U	6.7	119	0.51 U	3.4	97,200	15.0	6.2	29.1	14,800	4,080	488 U	NA	11.2	1,800	3.6 U	1.0 UJ	515 U	2.6 U	28.2	656
6224-32	2812-SS-G	227	18,100	6.3 U	9.4	219	0.64	4.6	13,300	19.2	12.3	31.5	18,800	2,660	750 U	NA	11.8	2,360	3.7 U	1.1 UJ	528 U	2.6 U	44.7	641
6224-33	2816-SS-C4	352	19,400	6.1 U	8.9	176	0.64	5.4	19,200	18.0	9.8	46.0	19,900	2,460	562 U	NA	15.5	2,330	3.5 U	1.1 J	506 U	2.5 U	37.1	1,330
6224-34	2905-SS-C3	162	19,400	6.0 U	7.0	187	0.79	3.1	6,110	20.0	9.0	25.8	19,700	2,190	568 U	NA	14.2	3,060	3.5 U	1.0 UJ	501 U	2.5 U	38.8	507
6224-34-FD	2905-SS-C3	186	18,700	6.0 U	7.5	270	0.77	3.4	7,560	20.2	16.4	26.9	19,800	2,130	1,240 U	NA	15.4	2,980	3.5 U	1.0 UJ	501 U	2.5 U	39.6	557
6224-36	2905-SS-E1	920	15,600	6.0 U	15.1	167	0.64	9.2	29,800	18.6	8.1	95.4	19,200	2,520	531 U	NA	16.8	2,870	3.5 U	3.3	502 U	2.5 U	29.7	2,200
6224-37	2917-SS-E1	1,520	18,900	6.0 U	38.2	217	0.77	12.4	22,100	20.6	12.0	135	26,500	2,550	764 U	NA	20.1	2,830	3.5 U	5.9	503 U	2.5 U	36.1	3,490
6224-38	2961-SS-E1	416	16,700	6.2 UJ	13.4	153	0.74	7.6	61,400	18.8	10.1	62.9	22,600	3,710	633 U	NA	20.9	2,830	3.6 U	1.0 UJ	513 U	2.6 U	31.7	1,660
6224-39	3312-SS-E1	208	19,100	6.1 U	5.8	171	0.65	4.3	19,300	19.0	8.3	34.8	20,200	2,560	629 U	NA	20.7	3,030	3.5 U	1.0 UJ	507 U	2.5 U	33.1	1,120
6224-39-FD	3312-SS-E1	202	18,200	6.1 U	5.3	158	0.64	4.0	17,700	18.0	6.7	34.4	18,800	2,400	486 U	NA	19.4	2,850	3.5 U	1.0 UJ	507 U	2.5 U	30.4	1,110
6224-41	3455-SS-C1	487 U	18,500	6.1 U	5.7 J	202	0.65	3.0	20,900	17.8	7.7	36.7	16,400	2,500	435	NA	14.3	3,100	3.6 U	1.0 UJ	508 U	2.5 UJ	30.1	634
6224-42	3455-SS-C2	449 U	16,100	6.1 U	7.0	177	0.64	3.7	103,000	18.2	7.7	51.6	15,500	3,400	495	NA	15.4	2,600	3.5 U	1.0 UJ	506 U	2.5 UJ	29.5	841
6224-43	3455-SS-C5	356 U	18,900	6.1 U	7.2	193	0.71	8.3	10,900	19.1	7.3	47.2	18,200	2,560	446	NA	16.5	3,120	3.6 U	1.0 UJ	508 U	2.5 UJ	31.3	1,310

Table 4.13 (Continued)
Analytical Data Summary - ASR 6224
Former United Zinc Site, Iola, Kansas

Sample ID	Sample Location	Pb*	Al	Sb	As*	Ba*	Be	Cd*	Ca	Cr	Co	Cu	Fe	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Tl	V	Zn*
6224-44	3459-SS-C4	288 U	15,200	6.1 U	53 J	137	0.54	7.6	38,300	15.0	5.1 U	42.5	13,300	2,780	343	NA	11.7	2,200	3.6 U	1.0 UJ	512 U	2.6 UJ	21.9	1,080
6224-45	3457-SS-LS	208 U	17,800	6.0 U	5.5 J	192	0.64	4.8	10,300	17.4	8.3	29.9	16,800	2,260	488	NA	15.0	2,230	3.5 U	1.0 UJ	504 U	2.5 UJ	30.1	694
6224-46	3844-SS-E1	218 U	21,700	6.2 U	6.1 J	191	0.78	2.9	62,000	21.5	12.6	35.5	19,800	4,050	606	NA	17.5	3,180	3.6 U	1.0 UJ	515 U	2.6 UJ	36.6	599
6224-47	4061-SS-LS	268 U	22,300	6.1 U	16.5	192	0.70	8.5	9,960	31.2	9.5	52.3	18,200	2,740	589	NA	15.1	2,560	3.5 U	1.0 UJ	505 U	2.5 UJ	38.7	1,050
6224-48	2023-SS-C2	213 U	19,300	6.1 UJ	5.2 J	128	0.61	2.9	40,600	19.0	8.5	21.6	17,500	2,920	471	NA	13.5	2,890	3.6 U	1.0 UJ	508 U	2.5 UJ	34.6	396 J
6224-49	2035-SS-C4	467 U	18,300	6.1 U	7.4	208	0.74	4.3	30,200	19.7	7.6	58.7	18,600	2,820	458	NA	14.9	2,690	3.5 U	1.2 J	507 U	2.5 UJ	34.6	942
6224-50	2978-SS-C1	679 U	17,000	6.1 U	21.1	195	0.62	6.0	38,400	17.9	7.6	59.0	20,200	2,610	487	NA	17.2	2,450	3.6 U	2.0 J	509 U	2.5 UJ	30.0	990
6224-51	3862-SS-C20	289 U	16,800	6.0 U	5.8 J	158	0.63	3.6	30,300	17.4	7.9	36.7	18,000	2,820	472	NA	14.3	2,750	3.5 U	1.0 UJ	502 U	2.5 UJ	31.9	776
6224-52	4030-SS-C2	485 U	20,000	6.4 U	7.4	182	0.66	14.5	5,920	17.9	8.2	65.0	17,700	2,230	569	NA	11.2	2,450	3.8 U	1.4 J	537 U	2.7 UJ	36.8	1,800
6224-52-FD	4030-SS-C2	521 U	20,000	6.5 U	8.2	188	0.68	15.1	5,810	18.1	9.1	65.7	18,300	2,210	669	NA	11.5	2,460	3.8 U	1.4 J	539 U	2.7 UJ	39.0	1,840
6224-54	4030-SS-C4	531 U	18,700	6.4 U	9.1	193	0.66	14.8	4,550	16.9	11.3	61.8	18,600	2,040	833	NA	10.1	2,210	3.7 U	1.4 J	530 U	2.7 UJ	40.2	1,810
6224-54-FD	4030-SS-C4	551 U	20,100	6.4 U	8.9	192	0.66	15.4	4,620	18.2	12.1	63.6	19,100	2,160	797	NA	10.8	2,350	3.7 U	1.4 J	531 U	2.7 UJ	42.2	1,850
6224-56	4030-SS-C6	576 U	20,200	6.4 U	10.0	182	0.67	16.0	4,490	18.8	9.1	71.7	19,600	2,130	707	NA	10.5	2,670	3.7 U	1.7 J	532 U	2.7 UJ	43.6	1,940
6224-56-FD	4030-SS-C6	596 U	19,700	6.4 U	10.0	199	0.68	16.0	4,360	18.6	12.5	69.9	19,200	2,060	910	NA	10.8	2,590	3.8 U	1.7 J	536 U	2.7 UJ	43.2	1,910
6224-58	4030-SS-PA1	817 U	17,400	6.0 U	13.3	163	0.62	14.3	3,500	17.0	20.6	70.2	19,500	1,790	821	NA	11.8	1,760	3.5 U	2.0 J	504 U	2.5 UJ	48.3	1,560
6224-58-FD	4030-SS-PA1	750 U	17,400	6.0 U	13.1	157	0.65	14.3	3,500	16.9	10.9	70.2	19,500	1,800	594	NA	10.9	1,790	3.5 U	1.9 J	504 U	2.5 UJ	49.2	1,550
6224-60	2127-SS-C2	343 U	18,600	6.3 U	8.3	182	0.62	4.8	16,900	19.5	8.8	57.9	19,500	2,420	423	NA	13.4	2,440	3.7 U	1.0 UJ	525 U	2.6 UJ	41.1	932
6224-61	2154-SS-C1	238	23,500	6.0 U	9.8	180	1.1	2.4	24,500	23.9	8.7	25.6	22,800	2,990	583	NA	19.9	3,710	3.5 UJ	1.0 UJ	501 U	2.5 UJ	35.4	608
6224-62	2722-SS-C1	651	14,100	7.0 U	11.4	178	0.63	6.7	49,100	17.5	7.3	82.5	18,200	3,630	469	NA	14.1	2,130	4.1 UJ	4.0	583 U	2.9 UJ	26.9	1,390
6224-63	2805-SS-C2	292	17,700	N/A R	9.5	192	0.86	3.6 J	11,000	20.4	8.2	36.2	19,700	2,490	471	NA	19.3	3,000	3.8 UJ	1.1 UJ	546 U	2.7 UJ	32.0	973
6224-64	2806-SS-C1	447	15,300	6.5 U	10.8	164	0.85	5.4	50,900	18.8	7.1	46.1	18,300	2,910	438	NA	22.6	2,530	3.8 UJ	1.2 J	539 U	2.7 UJ	28.9	1,260
6224-65	3145-SS-C1	668	14,000	6.1 U	12.8	189	0.79	5.9	13,900	18.9	8.9	51.1	21,800	2,180	572	NA	15.3	2,020	3.5 UJ	1.3 J	506 U	2.5 UJ	32.3	1,450
6224-66	3145-SS-E1	1,150	13,100	6.1 U	30.7	157	0.67	13.2	37,200	17.6	8.5	121	20,400	3,350	750	NA	16.8	1,770	3.6 UJ	5.1	509 U	2.5 UJ	29.6	3,150
6224-67	3229-SS-C1	503	17,800	6.1 U	9.9	198	0.83	5.9	14,000	21.0	10.3	43.9	18,400	2,190	672	NA	16.1	2,110	3.6 UJ	1.0 UJ	512 U	2.6 UJ	36.2	1,750
6224-68	3950-SS-C3	227	19,800	6.4 U	8.4	196	0.87	2.9	16,500	20.2	7.5	40.0	15,700	2,600	475	NA	15.8	3,030	3.7 UJ	1.1 UJ	535 U	2.7 UJ	34.4	715
6224-69	4055-SS-E1	676	20,400	7.1 U	16.4	175	0.93	5.8	24,300	22.5	9.9	65.9	21,000	2,520	860	NA	18.9	2,210	4.1 UJ	2.1	589 U	2.9 UJ	40.2	1,710
6224-70	2285-SS-C1	354	16,900	6.0 U	9.4	211	0.85	2.8	11,300	18.9	8.1	32.3	16,600	2,220	583	NA	15.4	2,430	3.5 UJ	1.0 UJ	500 U	2.5 UJ	32.7	687
6224-71	3073-SS-C1	821	21,100	7.4 U	15.2	174	0.95	14.9	7,810	20.4	8.0	84.7	20,500	2,480	639	NA	15.4	2,430	4.3 UJ	3.2	618 U	3.1 UJ	40.3	2,510
6224-72	3150-SS-C1	295	19,800	6.8 U	8.7	124	0.77	6.5	4,140	19.1	9.8	28.5	17,700	1,820	570	NA	11.7	1,670	4.0 UJ	1.1 UJ	565 U	2.8 UJ	39.1	1,020
6224-73	2071-SS-C1	551	21,300	6.1 U	16.7	251	1.0	3.9	13,100	22.0	13.7	63.7	23,100	2,590	898	NA	23.4	2,530	3.6 UJ	1.8	512 U	2.6 UJ	41.5	1,390
6224-74	2081-SS-C2	272	18,700	6.0 U	8.3 J	198	0.94	2.4	23,700	21.2	8.5	32.7	19,000	3,140	531	NA	19.2	2,640	3.5 UJ	1.0 J	504 U	2.5 UJ	32.8	734
6224-75	2081-SS-C4	194	22,700	6.1 U	7.7 J	207	1.0	2.4	22,900	23.5	14.7	27.7	21,000	3,160	750	NA	22.6	3,090	3.5 UJ	1.0 UJ	507 U	2.5 UJ	38.9	550
6224-76	2110-SS-C3	301	18,600	6.3 U	11.6	212	0.82	2.9	21,200	19.4	6.3	33.6	15,900	2,740	309	NA	15.3	2,320	3.7 UJ	1.1 UJ	529 U	2.6 UJ	32.2	835
6224-77	2116-SS-E1	617	17,500	6.1 U	11.1	151	0.77	4.4	30,700	21.8	9.4	58.9	18,100	2,990	736	NA	18.3	2,100	3.5 UJ	1.5 J	506 U	2.5 UJ	33.7	1,550
6224-78	2268-SS-C4	238	14,900	6.2 U	10.7	149	0.73	2.1	5,500	17.2	7.6	22.4	14,900	1,710	532	NA	12.2	1,880	3.6 UJ	1.0 UJ	515 U	2.6 UJ	32.3	754
6224-79	2268-SS-E1	238	10,000	6.7 U	6.2 J	93.9	0.56 U	2.7	9,490	11.4	5.6 U	22.2	10,800	1,460	303	NA	8.4	1,370	3.9 UJ	1.1 UJ	559 U	2.8 UJ	20.2	620
6224-80	2432-SS-C1	331	15,700	6.0 U	9.6	153	0.82	3.1	19,300	18.6	13.3	35.4	16,400	2,380	664	NA	15.3	2,110	3.5 UJ	1.0 J	503 U	2.5 UJ	32.3	865
6224-81	2433-SS-E1	2,550	19,900	6.1 U	49.5	213	1.0	9.0	20,000	21.2	9.2	289	27,100	2,610	961	NA	24.7	2,300	3.5 UJ	9.4	507 U	2.5 UJ	35.6	4,150
6224-82	2803-SS-C1	419	18,900	6.1 U	17.5	230	1.0	4.9	9,850	22.4	16.2	55.5	23,500	2,540	1,030	NA	24.9	3,100	3.5 UJ	1.0 UJ	507 U	2.5 UJ	40.0	1,240
6224-83	2957-SS-C1	375	18,200	6.2 U	9.6	163	0.88	8.0	46,500	21.8	8.7	44.8	19,100	2,690	482	NA	16.8	2,500	3.6 UJ	1.6	513 U	2.6 UJ	37.2	1,750
6224-84	2957-SS-C3	686	18,200	6.1 U	12.9	197	0.95	12.3	16,400	21.3	9.4	58.2	20,900	2,410	631	NA	15.3	1,950	3.5 UJ	2.4	505 U	2.5 UJ	41.6	2,300
6224-85	3413-SS-C14	1,390	21,600	6.3 U	10.4	201	0.97	3.2	9,650	22.7	11.1	47.9	21,300	3,430	729	NA	23.5	4,380	3.7 UJ	2.1	522 U	2.6 UJ	34.9	1,230
6224-86	3444-SS-C1	273	17,300	6.6 U	6.7 J	199	0.83	3.6	9,980	19.0	8.1	24.8	16,500	2,260	578	NA	16.3	2,490	3.8 UJ	1.1 UJ	548 U	2.7 UJ	31.9	725

Table 4.13 (Continued)
Analytical Data Summary - ASR 6224
Former United Zinc Site, Iola, Kansas

Sample ID	Sample Location	Pb*	Al	Sb	As*	Ba*	Be	Cd*	Ca	Cr	Co	Cu	Fe	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Tl	V	Zn*
6224-87	3472-SS-PA	4,950	21,200 J	9.0	117	178	1.1	9.7	5,500	23.1	14.2	326	26,900	2,120	1,190	NA	32.3	2,080	3.8 UJ	13.8	548 U	2.7 UJ	47.0	6,540
6224-88	3472-SS-E1	982	30,400 J	6.5 U	62.6	241	1.3	15.7	10,000	31.0	18.0	144	29,400	2,460	887	NA	30.5	2,540	3.8 UJ	1.1 UJ	539 U	2.7 UJ	53.5	9,410
6224-89	3611-SS-E2	333	9,820 J	6.1 U	6.3 J	104	0.54	2.5	156,000	18.4	5.9	16.6	15,600	5,380	582	NA	14.0	1,350	3.5 UJ	1.0 UJ	507 U	2.5 UJ	26.8	464
6224-90	3863-SS-C2	382	21,600 J	6.6 U	10.8	178	0.99	3.2	22,800	24.0	8.6	47.2	21,800	2,870	589	NA	20.4	2,740	3.8 UJ	1.1 UJ	549 U	2.7 UJ	37.5	955
6224-91	1380-SS-E1	185	21,500 J	6.0 U	6.1 J	189	1.0	2.3	40,400	24.6	8.2	20.7	20,500	4,220	567	NA	22.1	3,880	3.5 UJ	1.0 UJ	503 U	2.5 UJ	34.2	409
6224-92	2071-SS-C2	328	14,500 J	6.2 U	10.8	166	0.63	2.2	17,700	15.0	7.6	37.4	15,300	2,240	461	NA	11.7	2,120	3.6 UJ	1.0 UJ	518 U	2.6 UJ	29.1	707
6224-93	2081-SS-E1	744	14,600 J	6.1 U	47.3	167	0.75	8.1	85,900	18.2	7.0	83.2	22,400	4,380	652	NA	17.1	1,640	3.5 UJ	2.9	507 U	2.5 UJ	34.5	2,270
6224-94	2302-SS-PA1-C3	338	20,500 J	6.2 U	11.0	161	0.98	2.4	8,010	21.8	6.7	29.3	19,300	3,140	420	NA	18.5	3,290	3.6 UJ	1.0 UJ	520 U	2.6 UJ	33.0	835
6224-95	3365-SS-C1	262	22,500 J	6.2 U	11.1	175	1.1	6.7	5,510	23.2	9.2	24.7	24,400	2,210	897	NA	21.5	2,480	3.6 UJ	1.0 UJ	515 U	2.6 UJ	42.0	1,160
6224-96	3365-SS-C2	276	21,400 J	6.2 U	11.3	167	1.0	7.1	4,780	22.7	8.3	23.9	23,800	1,980	932	NA	21.3	2,320	3.6 UJ	1.0 UJ	514 U	2.6 UJ	40.4	1,200
6224-97	3365-SS-C4	278	22,600 J	6.2 U	11.6	178	1.1	7.1	5,100	24.0	9.5	23.8	25,100	2,060	1,120	NA	28.3	2,510	3.6 UJ	1.0 UJ	515 U	2.6 UJ	41.8	1,240
6224-98	3413-SS-C26	223	11,000 J	6.1 UJ	5.3 J	114	0.57	2.8	210,000	19.7 J	5.0 U	33.1	15,400	6,160	536	NA	15.5	1,810	3.5 UJ	1.0 UJ	505 U	2.5 UJ	21.7	676
6224-99	3458-SS-C22	279	17,500 J	6.1 U	8.4	197	0.77	3.9	19,600	20.2	8.1	33.0	17,700	2,290	622	NA	17.0	2,540	3.5 UJ	1.0 UJ	506 U	2.5 UJ	30.6	841
6224-100	3459-SS-C11	225	19,600 J	6.1 U	10.5	192	0.82	2.8	8,030	20.4	9.6	31.8	19,100	2,300	722	NA	16.9	3,090	3.6 UJ	1.0 UJ	510 U	2.6 UJ	34.2	542
	Residental Soil RSL	400	7,700	3.1	0.67	1500	16	7	nsv	0.3	2.3	310	5,500	nsv	180	39	150	nsv	39	39	nsv	0.078	39	2,300

Notes:

All samples were analyzed by the EPA Region 7 laboratory for Target Analyte List metals.

The analytical results and RSLs are in milligrams per kilogram

* = Indicates a site related metal typically associated with lead and zinc mining and smelting activities.

Bold = analyte detected

Shaded analyte concentrations exceed EPA RSL for Residential Soil (May 2014).

RSL for noncancer metals have been adjusted down by a factor of 10.

Element Symbols: Ag - Silver, Al - Aluminum, As - Arsenic, Ba - Barium, Be - Beryllium, Ca - Calcium, Cd - Cadmium, Co - Cobalt, Cr - Chromium, Cu - Copper, Fe - Iron,

K - Potassium, Mg - Magnesium, Mn - Manganese, Mo - Molybdenum, Na - Sodium, Ni - Nickel, Pb - Lead, Sb - Antimony, Se - Selenium, Tl - Thallium, V - Vanadium, Zn - Zinc.

EPA = U.S. Environmental Protection Agency

ID = identification

J = The identification of the analyte is acceptable; the reported value is an estimate.

NA = not analyzed

nsv = no screening value

RSL = regional screening level

U = The analyte was not detected at or above the associated reporting limit.

UJ = The analyte was not detected at or above the associated reporting limit; the reported value is an estimate.

Table 4.14
Arsenic Reanalysis Study Lead and Arsenic Screening Data Soils - Range of Detections
Former United Zinc Site, Iola, Kansas

Analyte	Depth	Residential Soil RSL	Detection Range[2]		Number of Detections[1]	RSL Exceedances
			Minimum	Maximum		
Lead	Surface	400	14	1,552	2,822	104
	0-6 inches		51	443	16	3
	6-12 inches		0	0	0	0
	12-18 inches		0	0	0	0
	18-24 inches		0	0	0	0
Arsenic	Surface	0.67	3.4	118	2,822	2,822
	0-6 inches		7.0	19.1	16	16
	6-12 inches		0	0	0	0
	12-18 inches		0	0	0	0
	18-24 inches		0	0	0	0

Notes:

[1]The number of lead detections matches the number of samples analyzed for a particular interval.

[2]Results used are for the arsenic reanalysis study in 2015 and 2016.

There were 2,822 surface soil samples screened along with 16 subsurface soil samples.

The analytical results and RSLs are in milligrams per kilogram.

EPA = U.S. Environmental Protection Agency

RSL = EPA Regional Screening Level for Residential Soil (May 2014)

APPENDIX A

SUMMARY OF FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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Appendix A
Federal Action-Specific ARARs
Former United Zinc Site
Iola, Kansas

	Citation	Description
A. Applicable or Relevant and Appropriate Requirements (ARARs)		
1. Clean Water Act	National Pollutant Discharge Elimination System (NPDES) 40 CFR Parts 122-125.	Requires permits for the discharge of pollutants from any point source into the waters of the United States.
2. Clean Water Act	Water Quality Criteria, 40 CFR Part 131, Water Quality Standards.	Establishes non-enforceable standards to protect aquatic life.
3. Noise Control Act of 1972	42 USC Section 4901 et seq.	Federal activities must not result in noise that will jeopardize the health or welfare of the public.
4. NPDES Storm Water Discharge for Permanent Repository	40 CFR, Part 122, 122.25.	Establishes permitting process and discharge regulations for stormwater. Requires management of repository where waste materials come into contact with storm water. Also required during construction of the repository.
5. RCRA	Subtitle D, 42 U.S.C §6941 et seq.	Establishes disposal processes.
6. RCRA	Subtitle C, 42 U.S.C §6921 et seq.	Establishes procedures for the handling of hazardous waste if material fails TCLP analysis
7. DOT Hazardous Material Transportation	49 CFR Parts 107, 171-177	Establishes procedures for transportation of hazardous waste.
B. To Be Considered		
1. Safe Drinking Water Act	Standards for Owners and Operators of Public Water Supply Systems.	Provides treatment (water quality) requirements for public water supply.
2. Safe Drinking Water Act	Underground Injection Control (UIC) Regulations. 40 CFR, Parts 144-147.	Provides for protection of underground sources of drinking water.
3. Clean Water Act	Toxic Pollutant Effluent Standards 40 CFR, Part 129.	Establishes effluent standards or prohibitions for certain toxic pollutants.
4. Clean Water Act	National Pretreatment Standards 40 CFR, Part 403.	Sets standards to control pollutants that pass through or interfere with treatment processes in POTWs or that may contaminate sewage sludge.
5. EPA Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites	Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration, OSWER Directive 9283 (EPA/540/G-88/003).	Guidance focuses on the development, evaluation, and selection of groundwater remedial actions at Superfund sites. This guidance discusses ARARs and should be considered for alternatives that involve groundwater remedial actions.

Appendix A
Federal Chemical-Specific ARARs
Former United Zinc Site
Iola, Kansas

	Citations	Description
A. ARARs		
1. Safe Drinking Water Act	National Primary Drinking Water Standards 40 Code of Federal Regulations (CFR) Part 141 Subpart B and G.	Establishes maximum contaminant levels (MCLs), which are health based standards for public water systems.
B. To Be Considered		
1. Safe Drinking Water Act	National Secondary Drinking Water Standards, 40 CFR Part 143.	Establishes secondary maximum contaminant levels (SMCLs) which are non-enforceable guidelines for public water systems to protect the aesthetic quality of the water. SMCLs may be relevant and appropriate if groundwater is used as a source of drinking water.
2. Safe Drinking Water Act	Maximum Contaminant Level Goals (MCLGs), 40 CFR Part 141, Subpart F.	Establishes non-enforceable drinking water quality goals. The goals are set to levels that produce no known anticipated adverse health effects. The MCLGs include an adequate margin of safety.
3. Clean Water Act	Water Quality Criteria, 40 CFR Part 131 Water Quality Standards.	Establishes non-enforceable standards to protect aquatic life. May be relevant and appropriate to surface water discharges, or may be a TBC.
4. Clean Water Act	Toxic Pollutant Effluent Standards, 40 CFR Part 129.	Establishes effluent standards or prohibitions for certain toxic pollutants.
5. Clean Water Act	National Pollutant Discharge Elimination System (NPDES), 40 CFR Parts 122, 125.	Determines maximum concentrations of the discharge of pollutants from any point source into water of the United States.
6. Clean Water Act	National Pretreatment Standards, 40 CFR Part 403.	Sets standards to control pollutants that pass through or interfere with treatment processes in publicly owned treatment works (POTWs) or that may contain sewage sludge.
7. Clean Air Act	National Primary and Secondary Ambient Air Quality Standards 40 CFR Part 50	Establishes Standards for ambient air quality to protect public health and welfare Establishes Standards for ambient air quality to protect public health and welfare.

Appendix A
Federal Chemical-Specific ARARs (continued)
Former United Zinc Site
Iola, Kansas

	Citations	Description
B. To Be Considered (Continued)		
8. Baseline Human Health Risk Assessment (HHRA)	Draft Remedial Investigation Report, Former United Zinc, Iola, Kansas: Appendix B (Draft Human Health Risk Assessment), May 2015.	This document evaluated the baseline health risk from current site exposures and established contaminant levels in environmental media at the site for the protection of public health.
9. Superfund Lead-Contaminated Residential Sites Handbook	Environmental Protection Agency (EPA) Office of Solid Waste and Emergency Response (OSWER) 9285.7-50, August 2003.	Handbook developed by EPA to promote a nationally consistent decision making process for assessing and managing risks associated with lead-contaminated residential sites across the country.

Appendix A
Federal Location-Specific ARARs
Former United Zinc Site
Iola, Kansas

	Citation	Description
A. ARARs		
1. Historic project owned or controlled by a federal agency	National Historic Preservation Act: 16 United States Code (USC) 470, et seq.; 40 CFR § 6.301; 36 CFR Part I.	Property within areas of the site is included in or eligible for the National Register of Historic Places. The remedial alternatives will be designed to minimize the effect on historic landmarks.
2. Site within an area where action may cause irreparable harm, loss, or destruction of artifacts	Archeological and Historic Preservation Act; 16 USC 469, 40 CFR 6.301.	Property within areas of the site contains historical and archeological features. The remedial alternative will be designed to minimize the effect on historical and archeological features.
3. Site located in area of critical habitat upon which endangered or threatened species depend	Endangered Species Act of 1973, 16 USC 1531-1543; 50 CFR Parts 17; 40 CFR 6.302. Federal Migratory Bird Act; 16 USC 703-712.	Determination of the presence of endangered or threatened species. The remedial alternatives will be designed to conserve endangered or threatened species and their habitat, including consultation with the Department of Interior if such areas are affected.
4. Site located within a floodplain	Protection of Floodplains, Executive Order 11988; 40 CFR Part 6.302, Appendix A.	Remedial action will take place within a 100-year floodplain. The remedial action will be designed to avoid adversely impacting the floodplain. Planning and budget considerations will account for potential flood hazards and floodplain management.
5. Site located within wetlands	Protection of Wetlands; Executive Order 11990, 40 CFR Part 6, Appendix A.	Remedial actions may affect wetlands. The remedial action will be designed to avoid adversely impacting wetlands wherever possible including minimizing wetlands destruction and preserving wetland value.
6. Structures in waterways	Rivers & Harbors Act, 33 CFR Parts 320-330.	Placement of structures in waterways is restricted to pre-approval by the U.S. Army Corps of Engineers.
7. Area containing fish and wildlife habitat	Fish and Wildlife Conservation Act of 1980, 16 USC Part 2901 et seq.; 50 CFR Part 83 and 16 USC Part 661, et seq. Federal Migratory Bird Act, 16 USC Part 703.	Regulates activity affecting wildlife and non-game fish. Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.

Appendix A
Federal Location-Specific ARARs (continued)
Former United Zinc Site
Iola, Kansas

	Citation	Description
A. ARARs (continued)		
8. Wild and Scenic River Act	16 USC 1271 et seq.; Section 7, 40 CFR 6.302(e).	Prohibits adverse effects on any of the scenic rivers listed in 16 USC 1276(a).
9. Fish and Wildlife Coordination Act	16 USC Section 661 et seq.; 33 CFR Parts 320-330 40 C.F. R. 6.302.	Requires consultation when a federal department or agency proposes or authorizes any modification of any stream or other water body, and adequate provision for protection of fish and wildlife resources.
10. 100-year Floodplain	Location Standard for Hazardous Waste Facilities – Resource Conservation and Recovery Act (RCRA); 42 USC 6901; 40 CFR 264.18(b).	RCRA hazardous waste treatment and disposal. Facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout during any 100-year/24 hour flood.
11. Historic Site, Buildings, and Antiquities Act	16 USC Section 461 et seq. 40 CFR Section 6.301(a).	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks and to avoid undesirable impacts on such landmarks.
12. Salt Dome Formations, Salt Bed Formations, Underground Mines and Caves	40 CFR 264.18.	Placement of non-containerized or bulk liquid RCRA hazardous waste is prohibited within salt dome formations, underground mines, or caves.
B. To Be Considered		
1. Clean Water Act	Dredge or Fill Requirements (Section 404), 40 CFR Parts 230 and 231.	Requires permits for discharge of dredged or fill material into navigable waters.
2. Wilderness Act	16 USC 1311 et seq.; 50 CFR 35.1 et seq.	Requires that federally owned wilderness areas are managed to insure they are not impacted.
3. EPA Regulations on Sole-Source Aquifers	40 CFR 149.	No activities, including drilling, in an area designated a sole-source aquifer may take place without permission of the EPA.

Appendix A
State Action-Specific ARARs
Former United Zinc Site
Iola, Kansas

	Citation	Description
A. ARARs		
1. Kansas Board of Technical Professions	Kansas Department of Health and Environment, K.A.R. 66-6 through 66-14	Establishes the requirements for licensing of engineers, site surveyors, geologist and architects.
2. Ambient Air Quality Standards and Air Pollution Control	Kansas Department of Health and Environment, K.A.R. 28-19	Regulates air emissions from processing operations, indirect heating equipment, and incinerators. Establishes requirements for Attainment and Non-Attainment Areas. Establishes requirement for Stack Heights. Restricts open burning.
3. Spill Reporting	Kansas Department of Health and Environment, K.A.R. 28-48	Requires reporting of unpermitted discharges or accidental spills. Requires that containment and immediate environmental response measures are implemented.
B. To Be Considered - None		

Appendix A
State Chemical-Specific ARARs
Former United Zinc Site
Iola, Kansas

	Citation	Description
A. ARARs		
1. Kansas Water Appropriations Act	Kansas Department of Health and Environment, K.A.R. 5-1 through 5-10 and 5-50	Establishes the requirements for obtaining and maintaining and transferring water appropriations.
2. Hazardous Waste Management Standards and Regulations	Kansas Department of Health and Environment, Bureau of Waste Management, K.A.R. 28-31	Identifies the characteristics and listing of hazardous waste. Prohibits underground burial of hazardous waste except as granted by EPA or Kansas Department of Health and Environment (KDHE). Establishes restrictions on land disposal. Establishes standards for generators or transporters of hazardous waste. Establishes standards for hazardous waste storage, treatment and disposal facilities.
3. Water Pollution Control	Kansas Department of Health and Environment, K.A.R. 28-16	Provides regulation of sewage discharge. Establishes pre-treatment standards for industry. Designates uses of rivers and streams. Establishes River Basin Quality Criteria. Provides for establishment of Critical Water Quality Management Areas.
B. To Be Considered		
1. Voluntary Cleanup and Property Redevelopment Program	Kansas Department of Health and Environment, K.A.R. 28-71	Provides a mechanism for property owners. Facility operators, prospective purchasers, and local governments to voluntarily address contaminated properties with technical and regulatory guidance from KDHE.

Appendix A
State Location-Specific ARARs
Former United Zinc Site
Iola, Kansas

	Citation	Description
A. ARARs		
1. Kansas Historic Preservation Act	Kansas Department of Health and Environment, K.A.R. 118-3	Provides for the protection and preservation of sites and buildings listed on state or federal historic registries.
2. Non-Game, Threatened or Endangered Species	Kansas Department of Health and Environment, K.A.R. 115-5	Identifies Threatened and Endangered Species.
B. To Be Considered - None		

APPENDIX III

OTHER DOCUMENTS

Bureau of Environmental Remediation
Curtis State Office Building
1000 SW Jackson St., Suite 410
Topeka, KS 66612-1367

Kansas
Department of Health and Environment

phone: 785-296-2866
fax: 785-296-4823
chase@kdheks.gov
www.kdheks.gov

Susan Mosier, MD, Secretary

Sam Brownback, Governor

September 7, 2016

Brendan Corazzin
Office of Public Affairs
U.S. Environmental Protection Agency, Region 7
11201 Renner Blvd
Lenexa, KS 66219

Re: *Final Remedial Investigation Report, Former United Zinc Site, Iola, Kansas; Revised Final Feasibility Study, Former United Zinc Site, Iola, Kansas;* and *Proposed Plan, Residential Yard Soils, Former United Zinc Site, Iola, Kansas*

Dear Mr. Corazzin:

The Kansas Department of Health and Environment (KDHE) reviewed the referenced documents prepared by HydroGeologic, Inc., for the U.S. Environmental Protection Agency (EPA) and EPA. KDHE does not have any substantive comments regarding the referenced documents and supports the preferred alternative.

KDHE understands the proposed plan will address only residential and residential-like properties, and non-residential properties will be addressed under another operable unit (OU) called OU 02. Furthermore, the only changes from the ongoing removal action are decreasing the lead action level from 800 ppm to 400 parts per million (ppm) and establishing an arsenic action level at 35 ppm.

Feel free to contact me with any comments or questions using the information in the upper-right letterhead. Thank you for your consideration.

Sincerely,

Chris D. Hase

Chris D. Hase
Project Manager

Cc: Don Bahnke, EPA; Corey Schinstock, City of Iola; Joe Dom → File; United Zinc #1, C3-001-71726 (1)

From: Corazzin, Brendan
To: Bahnke, Don
Subject: FW: PIC- Iola KS-Fw: Form submission from: EPA in Kansas Contact Us about EPA in Kansas form
Date: Thursday, September 01, 2016 4:02:59 PM

Citizen comment is below.

-Brendan

From: VanDyke, Kim **On Behalf Of** R7 Actionline
Sent: Thursday, September 01, 2016 2:21 PM
To: Corazzin, Brendan <corazzin.brendan@epa.gov>
Subject: PIC- Iola KS-Fw: Form submission from: EPA in Kansas Contact Us about EPA in Kansas form

Brendan,
This e-mail came thru our PIC Line a few minutes ago about Iola KS. Please read the e-mail below and respond accordingly. Thanks for your help on this e-mail that came thru. Please FORWARD if this needs to go to someone else.

Thanks,
Kim Van Dyke EXT 7155
PIC Coordinator

From: drupal_admin@epa.gov <drupal_admin@epa.gov> on behalf of Julie Aubert via EPA <drupal_admin@epa.gov>
Sent: Thursday, September 1, 2016 1:12 PM
To: R7 Actionline
Subject: Form submission from: EPA in Kansas Contact Us about EPA in Kansas form

Submitted on 09/01/2016 2:12PM
Submitted values are:

Name: Julie Aubert
Organization:
Email: aubertacres@hotmail.com
Telephone Number:
Mailing Address: 201 N Sycamore, IOLA, KS, 66749
Comments: Comments: I could not attend the Iola Public Library meeting. My comments are that I think any site over 800 ppm should be cleaned up. My understanding is that several businesses have this. I think they should be cleaned up before the 400-800 ppm are. I don't think the 400-800 ppm need to be cleaned up at all especially if money is not available.

APPENDIX C

DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS FOR LEAD AND ARSENIC

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Memorandum

Via e-mail

DATE: May 18, 2016

TO: Todd Phillips and Don Bahnke (EPA)

FROM: Amber Bacom and Mark Follansbee (SRC)

SUBJECT: Preliminary Remediation Goals for Lead and Arsenic in Residential Soils at the Former United Zinc (FUZ) Site

1.0 INTRODUCTION

This memorandum presents preliminary remediation goals (PRGs) for lead and arsenic in surface soil at the Former United Zinc (FUZ) site. The FUZ human health risk assessment (HHRA) identified lead and arsenic as the principal chemicals of concern (COCs) in surface soil of residential yards (USEPA 2015). Thus, this memorandum is focused on deriving PRG values for these two COCs.

2.0 PRELIMINARY REMEDIATION GOALS (PRGs)

A PRG is the average concentration of a contaminant in a medium that is considered protective of human health for a specified land use. A PRG is used by risk managers mainly to help in a preliminary evaluation of the feasibility of various remedial alternatives. A PRG may undergo refinement during the Remedial Investigation and the Feasibility Study, taking a number of other considerations into account, ultimately resulting in a final remediation goal (RG) (USEPA 1991).

PRGs are calculated by taking the forward-going risk equation and solving the equation for the concentration that yields a specified target risk level. The PRG value for lead in residential soil represents the average concentration of lead in a residential yard that is associated with no more than a 5% chance that a child (age 0-84 months of age) living at the property will have a blood lead level that exceeds 10 µg/dL (USEPA 1998). The PRG value for arsenic in residential soil represents the average concentration of arsenic in a residential yard that is associated with a target hazard quotient (THQ) of 1 or a target cancer risk (TR) ranging between 1E-06 and 1E-04 (whichever produces the lower soil concentration).

3.0 METHOD FOR CALCULATING THE PRG FOR LEAD

Mathematical Model

The standard model developed by the USEPA to assess the risks of lead exposure in residential children is referred to as the Integrated Exposure Uptake Biokinetic (IEUBK) model (USEPA 1994). This model requires input data on the levels of lead in various environmental media at a specific location, and on the amount of these media contacted by a child living at that location. All of these inputs to the IEUBK

model are central tendency point estimates (i.e., arithmetic means or medians). These point estimates are used to calculate an estimate of the central tendency (the geometric mean, GM) of the distribution of blood lead values that might occur in a population of children exposed to lead under the specified conditions. Assuming the distribution is lognormal, and given (as input) an estimate of the variability between different children (this is specified by the geometric standard deviation or GSD), the model calculates the expected distribution of blood lead values, and estimates the probability that any random child might have a blood lead value over 10 µg/dL. For convenience, the probability of having a blood lead level above 10 µg/dL is referred to as P10.

The PRG is computed by finding the concentration of lead in soil that yields a P10 value equal to EPA's health-based goal (P10 ≤ 5%). This is done within the IEUBK model (Integrated Exposure Uptake Biokinetic Model for Lead in Children; Version 1.1 Build 11).

Input Parameters

The IEUBK model input parameters used in the PRG model runs are the same values used in the baseline human health risk assessment (USEPA 2015). These values are presented in Table 1. Most of the values are the national defaults recommended for use by USEPA (USEPA 1994). Some of the values (i.e., the relative bioavailability of lead and the concentration of lead in water) are based on site-specific data, as described in the HHRA (USEPA 2015).

4.0 METHOD FOR CALCULATING THE PRG FOR ARSENIC

The PRG for arsenic is computed in accordance with USEPA guidance (USEPA 1991). The same equations used in the HHRA (USEPA 2015) to calculate non-cancer hazard and cancer risk attributable to a specified exposure point concentration of a chemical were re-arranged to solve for the concentration of arsenic that corresponds to a specified target level. For arsenic, PRG values are calculated for both non-cancer effects and cancer effects. A non-cancer based PRG is based on exposure to a reasonably maximally exposed (RME) residential child (age 0-6 years). A cancer based PRG is based on exposure to a time-weighted average (TWA) resident.

For ingestion exposure to residential soil, the PRG equations are:

$$PRG(\text{non-cancer}) = (\text{Target HQ} \cdot AT \cdot BW) / (EF \cdot ED \cdot (RBA/RfD) \cdot IR \cdot CF)$$

$$PRG(\text{cancer}) = (\text{Target Risk} \cdot AT) / (SF \cdot RBA \cdot IFS \cdot CF)$$

Where:

IR = Intake rate of soil (mg/day).

BW = Body weight of the exposed person (kg).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

AT = Averaging time (days). For a chemical which causes non-cancer effects, the averaging time is equal to the exposure duration. For a chemical that causes cancer effects, the averaging time is 70 years.

RBA = Relative bioavailability (unitless).

CF = Conversion factor (kg/mg).

IFS = Soil intake factor (mg/kg). IFS = EFc · EDc · IRc / BWc + EFa · EDa · IRa / BWa where the "c" and "a" represent child and adult, respectively.

RfD = Oral reference dose (mg/kg-day)

SF = Cancer slope factor $(mg/kg\text{-}day)^{-1}$

For dermal exposure to residential soil, the PRG equations are:

PRG(non-cancer) = (Target HQ · AT · BW) / (EF · ED · (1/RfD · GIABS) · SA · AF · ABS_d · CF)

PRG(cancer) = Target Risk / (ABS_d · DFS · SF)

where:

GIABS = Gastrointestinal absorption (unitless).

SA = Exposed skin surface area (cm^2).

AF = Dermal adherence factor (mg/cm^2).

ABS_d = Dermal absorption fraction (unitless).

DFS = Soil dermal factor (mg/kg).
DFS = EFc · EDc · SAc · AFc / BWc + EFa · EDa · SAa · AFa / BWa where the "c" and "a" represent child and adult, respectively.

The total PRGs are computed as 1 / (1 / PRG(ingestion) + 1 / PRG(dermal)). This is done using the EPA Regional Screening Level (RSL) online calculator[1] and the site-specific input parameters described below.

[1] https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

Parameter Values

Exposure parameters and toxicity factors (RfD and SF) used to calculate the arsenic PRG are the same as were used in the HHRA to calculate non-cancer hazards to RME child resident and cancer risks to the TWA resident, as described in USEPA (2015). These values are summarized in Table 2.

For non-cancer, the target hazard quotient (HQ) was set to 1, while for cancer the target risk was set to 1E-04, 1E-05 or 1E-06.

5.0 RESULTS

5.1 Lead

Based on the approaches and inputs specified above and in Table 1, the PRG for lead in residential soil at the FUZ site is 423 mg/kg.

This PRG value for lead is somewhat uncertain, due to uncertainty in the true values of the input parameters used in the IEUBK model calculation. This uncertainty includes all of the inputs listed in Table 1. Of these parameters, the uncertainty in the soil and dust ingestion rates and in the true geometric standard deviation (GSD) are usually the most important. In addition to these user-adjustable parameters, there are also a large number of other pharmacokinetic variables that are used in the model but are not subject to revision by the model user.

For the purposes of this evaluation, a series of alternative PRG calculations were performed to evaluate the uncertainty in the PRG that arises from the site-specific relative bioavailability (RBA) term. Three alternative RBA values were evaluated. These values included the IEUBK model default RBA for lead (0.6), as well as a low estimate (0.49) and high estimate (0.79) based on site-specific data. All other input values were maintained at the values shown in Table 1. The alternative PRG estimates based on the different RBA values are:

Site-specific RBA (62%)	= 423 mg/kg
Default RBA (60%)	= 437 mg/kg
Low RBA (49%)	= 548 mg/kg
High RBA (79%)	= 326 mg/kg

Given the range of PRG estimates, the site-specific RBA of 423 mg/kg is considered the best estimate. However, most data on the concentration of lead in residential yards at the FUZ site are based on measurement of lead in soil using X-ray fluorescence (XRF). This complicates the use of the PRG of 423 mg/kg in that measurements of lead in soil using XRF are subject to a wide variety of interferences (e.g., water content, particle size, presence of other metals, etc.). Thus, to the extent that XRF yields a biased estimate of the true concentration, use of XRF data for comparison to the PRG might cause an error in either direction.

Because of the observable differences in lead concentrations associated with the potential for differences between XRF and ICP analytical techniques utilized at this site, the risk-based PRG of 423 mg/kg was converted to an ICP equivalent concentration.

In order to derive a site-specific XRF to ICP relationship, USEPA Region 7 collected paired measurements of the concentration of lead in bulk residential soil samples analyzed using ICP and XRF. Two individual sampling events were conducted in which 324 paired samples were collected from properties in 2006/2007 and 714 paired samples were collected from additional properties in 2013 (USEPA 2015). The data are shown in Figures 1 and 2. As shown, the XRF concentrations were better correlated with the ICP concentrations for the 2013 dataset ($R^2 = 0.9$) than the 2006/2007 dataset ($R^2 = 0.6$). As such, the relationship between the ICP and XRF measurements were modeled using the linear equation derived for the 2013 dataset:

$$\text{ICP-equivalent} = 1.1021 \cdot \text{XRF} + 19.872$$

The XRF PRG is computed by solving for the value that corresponds to an ICP value of 423 mg/kg:

$$\text{XRF PRG} = (423 - 19.872) / 1.1021 = 366 \text{ mg/kg}$$

Summary of Lead PRG

The risk-based PRG for lead in residential soil using ICP is 423 mg/kg. This corresponds to a PRG of 366 mg/kg in the bulk soil analyzed using XRF.

5.2 Arsenic

Based on the approaches and inputs specified above and in Table 2, the non-cancer and cancer-based PRGs for arsenic in residential soil at the FUZ site are:

Non-cancer PRG = 34.5 mg/kg

Cancer PRGs:
- Target risk 1E-06 = 0.67 mg/kg
- Target risk 1E-05 = 6.7 mg/kg
- Target risk 1E-04 = 67 mg/kg

As described in the HHRA, limited data (n = 5 samples) on arsenic concentrations in background soil samples collected 1.25 miles north of the FUZ site ranged from non-detect at a reporting limit around 4 mg/kg to 7.2 mg/kg (USEPA 2015). Arsenic concentrations reported by the U.S. Geological Survey (USGS) in background soils in counties near the FUZ site are around 8 to 12 mg/kg (USGS Pluto Database[2]). On this basis, the cancer PRGs based on target risks of 1E-06 and 1E-05 are likely below or

[2] USGS Pluto Database available online at: http://mrdata.usgs.gov/pluto/soil/. No data are available for Allen County. Data pulled from Shacklette H T for nearby Cherokee and Montgomery counties indicate arsenic concentrations measuring 8.3 and 12 mg/kg, respectively.

at background arsenic concentrations. Since the non-cancer PRG is the most conservative value compared to the cancer PRG based on a target risk of 1E-04, the PRG for arsenic in residential soil at the FUZ site is 35 mg/kg.

This PRG is appropriate for comparison to arsenic analyzed by an accurate laboratory method such as ICP spectrometry. Similar to lead, most data on the concentration of arsenic in residential yards at the FUZ site are based on XRF measurements. Because of the observable differences in arsenic concentrations associated with the potential for differences between XRF and ICP analytical techniques utilized at this site, the risk-based PRG of 35 mg/kg was converted to an ICP equivalent concentration.

In order to derive a site-specific XRF to ICP relationship, USEPA Region 7 re-analyzed archived residential soil samples collected in 2013 to generate paired measurements of the concentration of arsenic analyzed by ICP and XRF using 120 source seconds. Factors that contribute to the low correlation observed in the HHRA between arsenic ICP and arsenic XRF data include limited numbers of samples with detectable arsenic and potential interference from high lead concentrations. Focusing on soil samples with low lead concentrations (<400 mg/kg), ICP/XRF correlations were determined based only on those samples evaluated in the HHRA with a high arsenic concentration (>35 mg/kg) (referred to as "dataset 1") and based on re-analysis of all the samples collected in 2013 (referred to as "dataset 2"). The data are shown in Figures 3 and 4. As shown, the XRF concentrations were better correlated with the ICP concentrations for the dataset 1 ($R^2 = 0.9$) than for dataset 2 ($R^2 = 0.75$). As such, the relationship between the ICP and XRF measurements were modeled using the linear equation derived for dataset 1:

$$\text{ICP-equivalent(dataset 1)} = 1.1054 \cdot \text{XRF} - 0.0742$$

The XRF PRG is computed by solving for the value that corresponds to an ICP value of 35 mg/kg:

$$\text{XRF PRG(dataset 1)} = (35 + 0.0742) / 1.1054 = 32 \text{ mg/kg}$$

Summary of Arsenic PRG

The risk-based PRG for arsenic in soil measured using ICP is 35 mg/kg. This corresponds to a PRG of 32 mg/kg in soil analyzed using XRF.

6.0 REFERENCES

USEPA. 1991. Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). Interim. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. Publication Number 9285.7-01B. EPA/540/R-92/003.

USEPA. 1994. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. Publication Number 9285.7-15-1. EPA/540/R-93/081.

USEPA. 1998. Clarification to the 1994 Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive 9200.4-27. EPA/540-F98/030. August.

USEPA. 2015. Baseline Human Health Risk Assessment for the Former United Zinc Site, Iola, Kansas.

Table 1. IEUBK Model Inputs

CONSTANT MODEL INPUTS

PARAMETER	VALUE	BASIS
Soil concentration (mg/kg)	Decision Unit-specific weighted soil concentration	Time weighted soil lead concentration for each DU
Dust concentration (mg/kg)*	$C_{dust} = 0.7 \cdot C_{soil}$	Derived from residential soil lead concentration IEUBK Default (EPA 1994)
Air concentration (µg/m^3)	0.10	IEUBK Default (EPA 1994)
Indoor air concentration (µg/m^3)	30% of outdoors	IEUBK Default (EPA 1994)
Drinking water concentration (µg/L)	1.7	Site-specific value (90th percentile for City of Iola drinking water measured 2011-2013)
Absorption Fractions:		
Air	32%	IEUBK Default (EPA 1994)
Diet	50%	IEUBK Default (EPA 1994)
Water	50%	IEUBK Default (EPA 1994)
Soil/Dust (residential soil)	31%	Site-specific based on arithmetic mean RBA
RBA: Residential soil	62%	Site-specific arithmetic mean: See Table 5-2.
Sediment	60%	IEUBK Default (EPA 1994)
Fraction soil	45%	IEUBK Default (EPA 1994)
GSD	1.6	IEUBK Default (EPA 1994)

*Assuming that site soil will be tracked back to the residence by recreational visitors, this value is based on $C_{dust}=0.7 \cdot C_{soil(weighted)}$.

AGE DEPENDENT MODEL INPUTS*

	AIR		DIET	WATER	SOIL
Age	Time Outdoors (hrs)	Ventilation Rate (m^3/day)	Dietary Intake [1] (µg/day)	Intake (L/day)	Intake (mg/day)
0-1	1.0	2.0	2.26	0.20	85
1-2	2.0	3.0	1.96	0.50	135
2-3	3.0	5.0	2.13	0.52	135
3-4	4.0	5.0	2.04	0.53	135
4-5	4.0	5.0	1.95	0.55	100
5-6	4.0	7.0	2.05	0.58	90
6-7	4.0	7.0	2.22	0.59	85

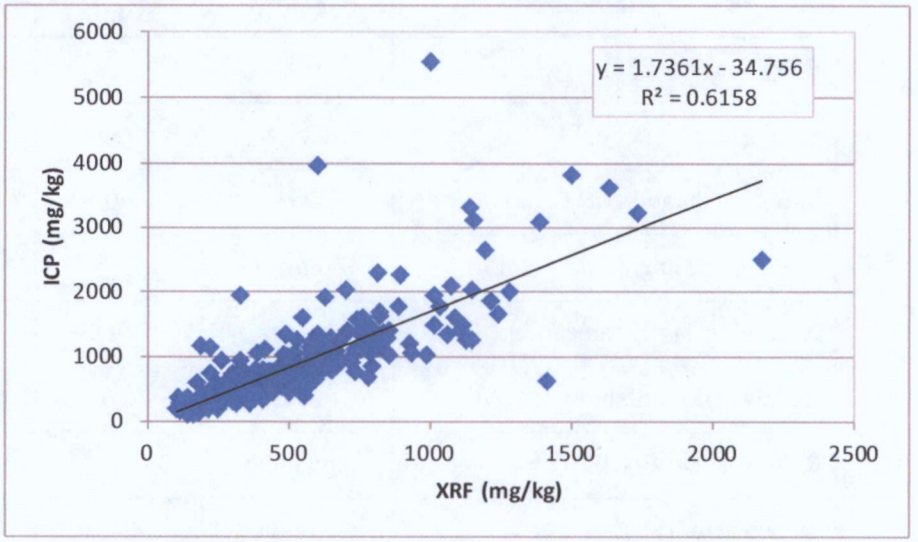
[1] Revised USEPA (2009) recommended dietary intake parameters, based on updated dietary lead intake estimates from the Food and Drug Administration Total Diet Study (FDA 2006) and food consumption data from NHANES III (CDC 1997).

Table 2. Arsenic Exposure Parameters and Toxicity Factors

Exposure Pathway	Exposure Input Parameter	Units	RME	
			Adult	Child
General	Body Weight (BW)	kg	80	15
	Exposure frequency (EF)	days/yr	350	350
	Exposure duration (ED)	yr	20	6
	Averaging Time, Cancer (AT)	days	25,550	25,550
	Averaging Time, Noncancer (AT)	days	7,300	2,190
	Relative Bioavailability (RBA)	days	0.6	0.6
	Reference Dose (RfD)	mg/kg-day	3.00E-04	3.00E-04
	Slope Factor (SF)	$(mg/kg\text{-}day)^{-1}$	1.50E+00	1.50E+00
Ingestion of Soil	Ingestion rate (IR)	mg/day	100	200
	Conversion factor (CF)	kg/mg	1E-06	1E-06
Dermal Exposure to Soil	Exposed Surface Area (SA)	cm^2/event	6,032	2,690
	Adherence Factor (AF)	mg/cm^2	0.07	0.2
	Dermal Absorption Fraction (ABSd)	unitless	0.03	0.03
	Conversion factor (CF)	kg/mg	1.00E-06	1.00E-06
	Gastrointestinal absorption (GIABS)	unitless	1	1

Figure 1. ICP/XRF Correlation Based on 2006/2007 Lead Data

Panel A: Linear



Panel B: Log-Transformed

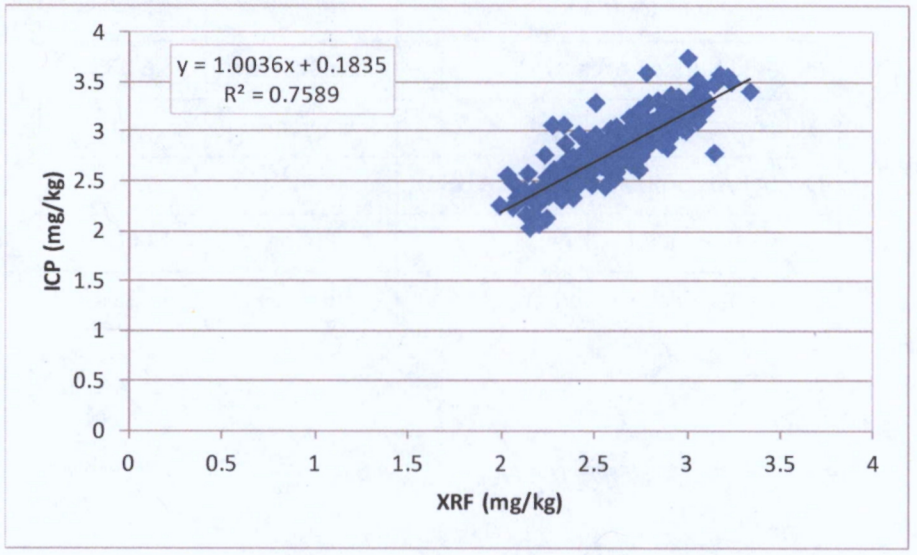
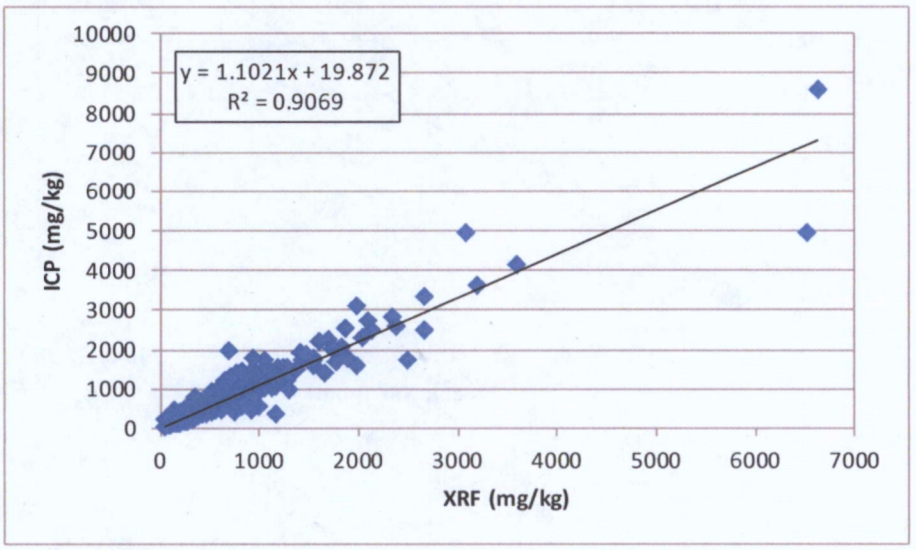


Figure 2. ICP/XRF Correlation Based on 2013 Lead Data

Panel A: Linear



Panel B: Log-Transformed

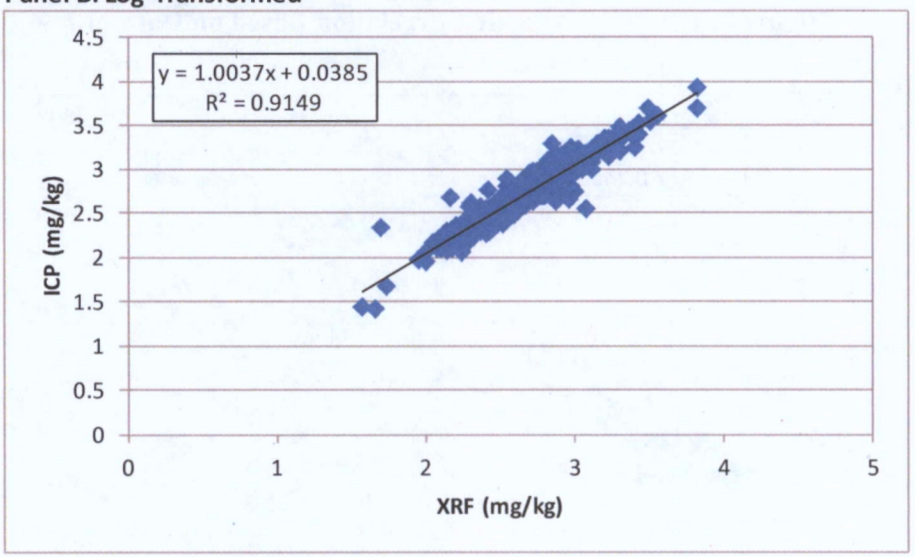


Figure 3. ICP/XRF Arsenic Correlation Based on Dataset 1

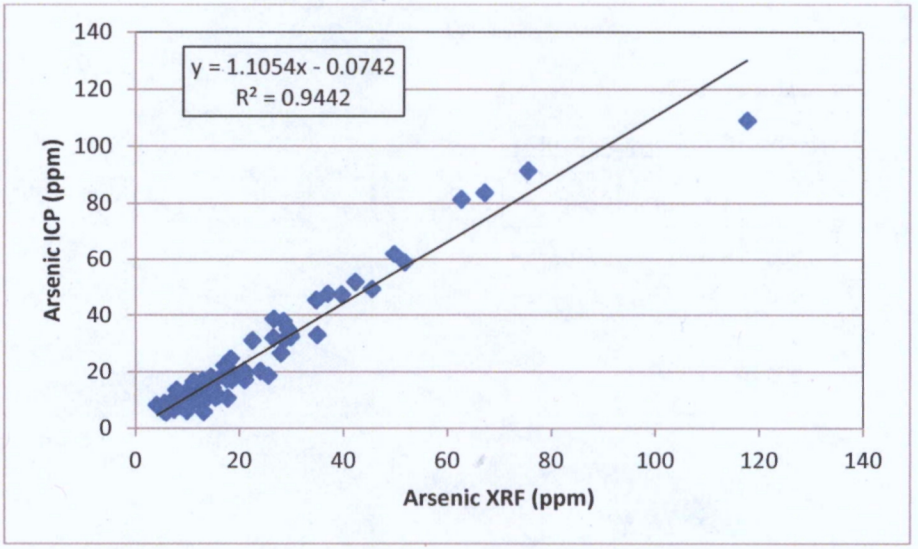
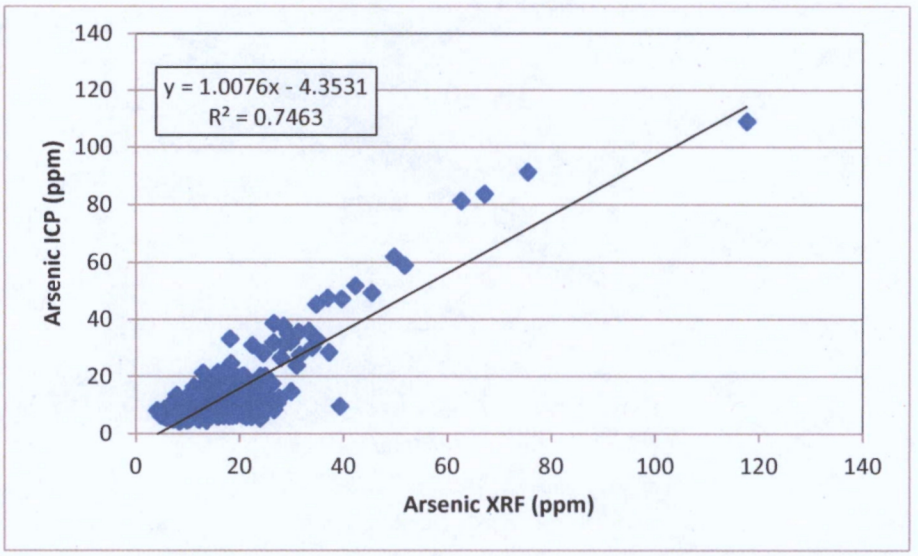


Figure 4. ICP/XRF Arsenic Correlation Based on Dataset 2



From: Madden, Venessa
To: Bahnke, Don; Phillips, Todd
Subject: RE: FUZ pets and lead contaminated soil
Date: Tuesday, September 20, 2016 8:53:46 AM

Don –

I went ahead and modeled exposure to domestic house pets (cats and dogs). Assuming average food ingestion rates and soil ingestion rates on the higher end of the range (4%), unsafe levels for pets are well above time critical removal action levels for residential soil (3800 to 5000 ppm). The diet is assumed to be pet food, so the only source of exposure is through incidental soil ingestion from digging, grooming, etc..

Hope that helps – I'm sure people ask this question a lot.

From: Bahnke, Don
Sent: Monday, September 19, 2016 3:41 PM
To: Madden, Venessa <Madden.Venessa@epa.gov>; Phillips, Todd <Phillips.Todd@epa.gov>
Subject: RE: FUZ pets and lead contaminated soil

Hi Venessa,
Thanks for looking into this. We consider this a formal comment that we received during a public meeting about the Proposed Plan.
There was a follow-up question about livestock too. Could you run numbers for some typical livestock too?
Both of these comments were made by Patricia Fail. See pages 20 and 27 of the attached transcript.
I will need to include your answers in the responsiveness summary.

From: Madden, Venessa
Sent: Monday, September 19, 2016 6:33 AM
To: Phillips, Todd <Phillips.Todd@epa.gov>; Bahnke, Don <bahnke.donald@epa.gov>
Subject: RE: FUZ pets and lead contaminated soil

Hi Don –

We typically don't evaluate domestic animals under ecological risk. However, I always try and answer these questions because I know how much people care for their pets! I can run some numbers based on incidental soil ingestion (I'm assuming they are eating pet food). Cats may get a little bit more exposure because they still hunt. I'll get back to you!

Venessa

From: Phillips, Todd
Sent: Friday, September 16, 2016 2:39 PM
To: Bahnke, Don <bahnke.donald@epa.gov>; Madden, Venessa <Madden.Venessa@epa.gov>

Subject: RE: FUZ pets and lead contaminated soil

Hi Don,

I'm also unable to answer that question. My recommendation is for them to contact their veterinarian.

Todd

Todd A. Phillips, Ph.D.
Toxicologist
Environmental Data & Assessment Branch
U.S. Environmental Protection Agency, Region 7
11201 Renner Boulevard
Lenexa, KS 66219
Phone: 913-551-7438

From: Bahnke, Don
Sent: Friday, September 16, 2016 2:31 PM
To: Phillips, Todd <Phillips.Todd@epa.gov>; Madden, Venessa <Madden.Venessa@epa.gov>
Subject: FUZ pets and lead contaminated soil

Hi Venessa and Todd,
We received a question during the Public Meeting that we could not answer.
How does the lead contaminated soil affect pets such as dogs and cats.
How would we answer this?

Don Bahnke
Environmental Protection Agency
11201 Renner Blvd
Lenexa, KS 66219
(913) 551-7747